federal register

THURSDAY, MARCH 2, 1978
PART II

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

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SUBSONIC TRANSPORT CATEGORY LARGE AIRPLANES AND TURBOJET POWERED AIRPLANES

Noise Limits and Acoustical Change Requirements; Aircraft Noise Measurement and Evaluation Specifications

[4910-13]

Title 14—Aeronautics and Space

CHAPTER I—FEDERAL AVIATION ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

[Docket No. 15131, Amdt. No. 36-8]

PART 36—NOISE STANDARDS: AIRCRAFT TYPE AND AIRWORTHINESS CERTIFICATION

Noise Limits and Acoustical Change Requirements for Subsonic Transport Category Large Airplanes and Turbojet Powered Airplanes

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This action amends the aircraft noise standards for certain turbojet airplanes and large transport airplanes (1) to prescribe amended noise limits for new airplane designs, (2) to limit noise level increases of certain older airplane types, if their designs are changed, and (3) to amend noise measuring points and noise test conditions. This amendment complements Federal Aviation Regulation Amendment 36-7 and includes minor modifications to the Stage 3 noise limits which became effective on October 1, 1977. This amendment also brings the U.S. aircraft noise standards into greater conformity with the international stand- ards recently adopted by the International Civil Aviation Organization (ICAO).

DATES: Effective date—April 3, 1978. Compliance/applicability dates—October 28, 1976, for applications for acoustical change approvals for Stage 2 airplanes; and November 5, 1975, for applications for new type certificates for Stage 3 airplanes.

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SUPPLEMENTARY INFORMATION:

Description of the Amendment

The purpose of this amendment to Part 36 of the Federal Aviation Regulations (FARs) is to amend the noise standards for subsonic transport category large airplanes and turbojet powered airplanes. These standards include noise limits, acoustical change requirements, noise measuring points and noise test conditions. This amendment has the following effects:

1. The interim takeoff, sideline, and approach noise limits under Appendix C (§ C36.5(a)(3)) for new airplane types ("Stage 3 airplanes") adopted in Amendment 36-7 (42 FR 12360; March 3, 1977) are amended as follows:

(a) For takeoff, the limits are reduced to 89 EPNdB for those airplanes with three engines and weights less than 63,177 pounds, and for those with more than three engines and weights less than 44,673 pounds.

(b) For sideline, the distinction in noise limits based on the number of engines is eliminated by reducing the limits for airplanes with three or more engines to coincide with the limits for airplanes with fewer than three engines.

(c) For approach, the limit of 105 EPNdB for airplanes with maximum weights of 850,000 pounds or more is applied to airplanes weighing 617,300 pounds or more; the 98 EPNdB limit for weights of 75,130 pounds or less is applied to weights of 77,200 pounds or less; the interim rate of noise reduction (for each 50 percent reduction ("halving") of the 617,300 pound weight in the noise limit provision) is increased from 2 EPNdB to 2.33 EPNdB.

2. The interim "acoustical change" provisions [§ 36.7(d)] which prohibit growth or other design changes that increase noise levels beyond prescribed limits, are amended for applications for approval made on or after October 28, 1976. This amendment prescribes more stringent requirements for older airplane types ("Stage 2 airplanes") that have high bypass ratio turbojet engines before the design change. It also prescribes noise limits applicable after a design change of the affected airplanes by prohibiting noise levels which exceed the Stage 2 noise limit or the Stage 3 noise limit by more than 3 EPNdB, whichever is lower.

3. The noise measuring points requirements for takeoff, sideline, and approach noise tests under Appendix C [§ C36.3] and the corresponding distances and related heights under Appendix A noise measurement provisions are amended as follows:

(a) For takeoff, the "3.5 nautical mile" distance from the start of roll is increased by 59 feet to 21,325 feet (6,500 meters).

(b) For sideline, the "0.25 nautical mile" distance from the extended centerline of the runway is decreased by 43 feet to 1,476 feet (450 meters).

(c) For approach, the "1 nautical mile" distance from the threshold is increased by 486 feet to 6,562 feet (2,000 meters); the related aircraft height above the approach noise measuring station and the reference approach minimum distance are increased by 22 feet to 394 feet and 393 feet, respectively.

4. The noise test conditions provision under Appendix C (§ C36.7(b)) applicable to new airplane types ("Stage 3 airplanes") is amended to provide different requirements, based on the number and type of engines. These requirements govern the altitudes at which power or thrust may be reduced during Part 36 noise compliance tests.

These amendments modify the interim amendments adopted in Amendment 36-7 and bring Part 36 noise standards into greater conformity with the international aircraft noise standards of the International Civil Aviation Organization contained in ICAO Annex 16. The FAA believes that the comparability of noise levels before and after a design change of an affected airplane is not significantly affected by this amendment.

The primary bases for this amendment are the proposals contained in Notice Nos. 75-37, 75-37B, and 75-37C (discussed in further detail under "Regulatory History"), which were issued under § 611(b) of the Federal Aviation Act of 1958, as amended by the Noise Control Act of 1972 (Pub. L. 92-574). In Notice No. 76-22 the U.S. Environmental Protection Agency (EPA) recommended adoption of the proposals in Notice Nos. 75-37, 75-37B, or 75-37C. Accordingly, this amendment accepts that EPA recommendation.

This amendment adopts the proposed changes to noise test distances in Appendix C. Since those distances are referred to in the noise test specifications prescribed under Appendix A, this amendment also adopts the necessary conforming amendments to Appendix A. (The affected provisions and tables, as amended, are also reflected in a separate rulemaking concerning revisions to Appendices A and B currently being considered by the FAA.)

Regulatory History

Notice No. 75-37 (40 FR 51476; Nov. 5, 1975) proposed to prescribe Part 36 standards in terms of three stages (or levels) of aircraft noise. It proposed noise limits and definitions for identifying those airplanes classified under each stage. That notice proposed to require those persons applying for new type certificates on or after November 5, 1975, to comply with the more stringent "Stage 3 noise level" limits. It also proposed to increase the stringency of the acoustical change requirements for "Stage 2" airplanes for which application for acoustical change approvals is made on or after November 5, 1975

Notice No. 75-37A, a notice of extension of the comment period, was published December 24, 1975 (40 FR 59447) in response to a petition for additional time for reviewing the proposal and submitting comments to the docket. The extended period also permitted time for commenters to submit views, information, and arguments re-

garding the expansion of the proposed rule announced in Notice No. 75-37B.

Notice No. 75-37B, a supplemental notice of proposed rulemaking published on February 9, 1976 (41 FR 5641), proposed to apply the proposals in Notice No. 75-37 to the type certification and acoustical change approval of single-engine turbojet powered airplanes and single-engine transport category large airplanes (regardless of engine type).

Notice No. 76-22: On October 1, 1976, pursuant to § 611(c)(1) of the Federal Aviation Act of 1958 (the Act), as amended, the EPA submitted its recommended regulation to amend FAR Part 36 noise standards to the FAA. The EPA proposal incorporated and supplemented the FAA proposals in Notice Nos. 75-37, 75-37B, and 75-37C. It also proposed (among other things) additional stages of noise reduction in 1980 and 1985. It would also extend the applicability of the noise standards to all propeller-driven large airplanes. The EPA recommended regulation, which was published as "Notice No. 76-22" (41 FR 47352; Oct. 28, 1976; as corrected at 41 FR 53807; Dec. 9, 1976), is duscussed in greater detail below.

Notice No. 75-37C, another supplemental notice of proposed rule making regarding FAR Part 36 noise standards, was also published in the FEDERAL REGISTER on October 28, 1976 (41 FR 47375). That notice proposed certain alternatives to the noise limits and acoustical change requirements previously proposed by the FAA. It was based primarily on recommended amendments to ICAO Annex 16 which were subsequently adopted with some modifications by the International Civil Aviation Organization. Those amendments are currently under consideration for implementation by the United States and other member States. Notice No. 75-37C also proposed to amend the noise-measuring-point distances in § C36.3 and to amend § C36.7(b) regarding the minimum altitude at which takeoff power or thrust may be reduced in demonstrating compliance with Part 36 noise limits.

FAR Amendment 36-7: On February 25, 1977, the FAA issued Amendment 36-7 to the Federal Aviation Regulations (42 FR 12360; March 3, 1977). That amendment, based on Notice Nos. 75-37 and 75-37B, revised portions of the Part 36 aircraft noise standards to provide (1) three stages of noise levels with prescribed limits, (2) definitions for classifying airplanes under each stage, and (3) Stage 3 noise limits and acoustical change requirements for new airplane type designs.

The preamble to that amendment discusses the relationship of that action to the proposed rules contained in Notice Nos. 75-37C and 76-22 which were not adopted at that time because the regulatory process had not been completed.

The period for submitting written comments to the Rules Docket on the proposals contained in Notice Nos. 75-37C (as well as Notice No. 76-22) closed on February 28, 1977. Accordingly, interested persons have been afforded an opportunity to participate in this rule making. All comments received have been considered in the issuance of this amendment.

Pursuant to § 611(b)(1) of the Act, the FAA has consulted with the Secretary of Transportation and the EPA prior to adoption of this amendment. A draft final environmental assessment regarding this amendment has been prepared in accordance with the National Environmental Policy Act of 1969 and implementing guidelines and directives. Also, this amendment was submitted to the EPA for review and comment prior to its adoption, pursuant to § 309 of the Clean Air Act, as amended (43 U.S.C. 1857h-7), and the guidelines of the Council on Environmental Quality (40 CFR 1500.9(b)). The FAA has reviewed the proposals adopted in this amendment under Executive Order 11821, as amended by Executive Order 11949, and under OMB Circular A-107 and determined that it does not contain a major proposal requiring preparation of an Economic Impact Statement.

RELATIONSHIP TO PRIOR RULEMAKING

GENERAL

This amendment is a part of the FAA's overall aircraft noise control and abatement program. The adoption of FAR Part 36 in 1969 prohibited further escalation of aircraft noise levels of subsonic civil turbojet and transport category airplanes and required new airplane types to be markedly quieter than the generation of turbojets that were developed in the late 1950's and early 1960's. Since the adoption of Part 36, the FAA has issued a number of notices proposing amendments to its provisions and, subsequent to notice and public procedure, has adopted those amendments which have been found to conform to the statutory authority and responsibility conferred upon the FAA by the Congress. Those amendments have increased the protection of the public health and welfare by providing control and abatement of aircraft noise and sonic boom under § 611 of the Act. Further amendments and proposed amendments are currently under consideration by the FAA for future issuance.

AMENDMENT 36-7

Under Amendment 36-7, the aircraft noise limits prescribed in Part 36 before adoption of the amendment are identified as "Stage 2" noise limits. Thus, a "Stage 2 airplane" is one that has been shown under Part 36 to comply with those requirements but does not conform to the more stringent Stage 3 requirements adopted in Amendment 36-7. A "Stage 1 airplane" means "an airplane that has not been shown under this part (Part 36) to create takeoff, sideline, and approach noise levels required for 'Stage 2 or Stage 3 airplanes.' "

The preamble to Amendment 36-7, stated that the FAA was continuing to consider further amendments based on the outstanding proposals, including (1) an acoustical change rule for Stage 2 airplanes, (2) a modification of Stage 3 noise limits, (3) amended noise test requirements to achieve the appropriate noise level reductions and to bring U.S. aircraft noise standards into closer conformity with international noise standards, and (4) rules based on the several proposals submitted to the FAA by the EPA under § 611(c) of the Act. This amendment augments the requirements adopted in Amendment 36-7 by adopting the proposals contained in Notice No. 75-37C, and without prejudging the final decision regarding the outstanding EPA proposals contained in Notice No. 76-22, discussed in more detail below.

AMENDMENT 91-136

In Amendment 91-136 (41 FR 56046; Dec. 23, 1976), the FAA adopted Subpart E to the Part 91 general operating rules. Subpart E contains an operating noise rule that requires certain previously excepted airplanes be brought into compliance with Federal noise limits in order to operate in the United States after compliance dates prescribed in a phased time schedule beginning in 1981 and ending in 1985. The applicable limits under Subpart E are the 1969 noise limits of Part 36, Appendix C (now called "Stage 2 noise limits"), that applied to applicants for type certificates through the early 1970's. Unlike the noise limits under Part 36, compliance with the Part 91 operating noise limits must be shown, with specific exceptions, without the use of the tradeoff provisions of § C36.5(b) of Part 36, Appendix C. Thus, compliance with the type certification/acoustical change noise rules, as amended herein, does not assure compliance with the continuing requirements of the operating noise rules in Part 91. Each of these rules is separate and distinct from the other, having its own compliance dates and noise limits. Further, FAA approval of an acoustical change under Part 36 does not automatically include authorization to operate that airplane in the United States after 1981 under Subpart E of Part 91, if that airplane is one for which tradeoffs are not permitted under Part 91. In short, when

the compliance dates in § 91.305 come into effect, they apply, notwithstanding the acoustical change provisions of Part 36, so far as operation in the United States is concerned.

Manufacturers, owners, and operators of "Stage 1 airplanes" (that is, airplanes not shown to comply with "Stage 2" noise limits) should note that those airplanes must, under Subpart E to Part 91, become and remain no noisier than the 1969 noise limits of Part 36, (now called "Stage 2 noise limits") without the use of the tradeoff provisions of Part 36 (except as provided in § 91.301(c)) in order to operate in the United States on and after the compliance dates specified in § 91.305. Nothing in this amendment affects this showing of compliance with these 1969 provisions of Part 36. However, for airplanes that are brought into compliance with the "Stage 2 noise limits," pursuant to Subpart E of Part 91, it should be noted that subsequent approvals of a change in type design, like any other "Stage 2 airplanes," are also governed by the Stage 2 acoustical change rule, as amended by this amendment (in addition to the continuing duty to comply with Subpart E of Part 91).

The EPA Recommended Regulation: Notice No. 76-22

As previously stated, on October 1, 1976, the EPA submitted to the FAA its recommended regulation which includes noise limits and acoustical change requirements for turbojet powered airplanes and propeller-driven large airplanes, pursuant to § 611(c)(1) of the Federal Aviation Act of 1958, as amended by the Noise Control Act of 1972 (Pub. L. 92-574). On November 29, 1976, the EPA submitted to the FAA a correction to its recommended regulation. The FAA has compared the EPA proposals with FAR Amendment 36-7 and the provisions of this amendment to determine whether issuance of the amendments would in any manner commit the FAA to a course of action that would conflict with an objective consideration of the EPA proposals under the procedures prescribed in § 611(c) of the Act, or would in other ways impair its ability to discharge its responsibilities under the Noise Control Act of 1972. That review focused primarily on those areas in which the proposals may differ with respect to the protection afforded to the public health and welfare from the noise of airplanes to which each would apply. The review also concerned the EPA's analysis and views regarding the FAA's proposals contained in Notice Nos. 75-37, 75-37B, and 75-37C. The EPA's analysis and views were set forth in Notice No. 76.22. The EPA recommends adoption of its recommended regulation, which it believes is necessary to protect the public health and welfare. A summary of the EPA proposals was presented in the preamble to FAR Amendment 36-7.

Based on its review, the FAA concludes that there is no provision of the EPA proposals submitted on October 1, 1976, or November 29, 1976, that could not be adopted later, if adoption is appropriate under the procedure and standards of § 611 of the Act. Furthermore, the FAA, by issuing this amendment at this time, in no way limits its ability or intent to respond fully to the EPA proposals in a manner contemplated by § 611(c).

The FAA is currently reviewing the EPA recommended regulation and the public comments presented at the hearing and to the Rules Docket. Accordingly, this amendment may be supplemented by further amendments based on the remaining EPA proposals and the comments received in response to those proposals. The FAA has considered the public need for timely action. It has determined that final action on all of the provisions of the remaining EPA proposals that are shown to be appropriate can be fully and objectively taken under § 611(c) of the Act. Therefore, the FAA believes that it would be contrary to the public interest, and to the intent of § 611, not to take this immediately available regulatory action while the regulatory process prescribed in the Act is being completed with respect to the remaining EPA proposals.

The Need for This Amendment

In addition to the reasons stated above and in the preamble to Amendment 36-7, the rules adopted in this amendment are also needed to achieve greater conformity between U.S. and international aircraft noise standards by eliminating any unnecessary discrepancies between the two. The United States, as a matter of international air transportation policy, encourages agreement on international environmental issues through the ICAO. This policy is intended to promote equal treatment for foreign and domestic aircraft manufacturers and operators through international standards and preclude unwarranted economic advantages or disadvantages among competitors which could be created in a world air transportation environment characterized by diverse national noise requirements. In Notice No. 75-37, the FAA stated its belief that, if adopted, the proposed amendments would result in significant improvement in noise levels of newly type certificated airplanes. Further, the FAA stated that the public health and welfare requires that progress be realized by those airplanes that will be using U.S. airports for decades to come. The FAA also stated that it believed that the proposals, if adopted on an international basis, would provide a major contribution to the limitation of aircraft noise nuisance at airports throughout the world. The FAA announced its intention to support adoption of the proposed rule by ICAO to achieve the recognized need for conformity. The FAA believed its responsibilities for the development of civil aviation and those under the Noise Control Act of 1972, nevertheless, required the initiation of regulatory proceedings leading to amendment of U.S. aircraft noise standards. Based on the noise reduction changes to Annex 16, recommended by ICAO CAN Working Group D, the FAA later proposed alternative noise level and acoustical change requirements in Notice No. 75-37C. Those recommended standards were modified and adopted at the fifth meeting of the ICAO Committee on Aircraft Noise. The FAA believes that the noise standards in this amendment are necessary to accomplish the beneficial objectives which were not fully achieved with the adoption of FAR Amendment 36-7. Those objectives include noise standards that are consistent with the purposes and requirements of § 611 of the Act and that are in greater conformity with the ICAO standards.

In order to prescribe appropriate noise limits for the affected aircraft and to achieve greater conformity with the international noise standards, the FAA concludes that it should also adopt the amendments involving aircraft noise test requirements proposed in Notice No. 75-37C. Thus, the noise-measuring-point distances in § C36.3 are amended in this amendment by slightly increasing the distance for the takeoff and approach tests and by decreasing the distance for the sideline noise test. Paragraph C36.7(b) is amended by reducing the altitudes at which takeoff thrust may be reduced to demonstrate compliance under Part 36. Some of these amendments, by themselves, in effect permit small noise level increases (as compared to interim requirements adopted in Amendment 36-7). However, the distances and altitudes were developed in conjunction with the noise limits and acoustical change requirements to ensure that the noise test procedures and the noise limits for different aircraft are adequately reflected in the overall aircraft noise standard. As stated in the preamble to Amendment 36-7, the FAA recognizes the need to cover a large range of airplane weights and designs and, therefore, suitable criteria for distinguishing among airplanes were considered and built into the proposals. Accordingly, the Stage 3 noise limits and Stage 2 acoustical change requirements reflect some refinements due to significant differences in noise emission characteristics among various airplane types. Howev-

er, contrary to that intention and the previous provisions of § 36.201, some of the words of applicability were inadvertently omitted in the revised § 36.201. Thus, this action includes corrective and clarifying amendments to § 36.201.

Discussion of Comments and the Rule

As previously stated, interested persons have been afforded the opportunity to participate in this rule making by submitting comments to the regulatory docket for Notice Nos. 75-37, 75-37B, and 75-37C. Those written comments have been reviewed and considered before issuing this amendment. A discussion of the comments in response to Notice Nos. 75-37 and 75-37B is presented in the preamble to Amendment 36-7.

Nine comments were received from the public in response to Notice No. 75-37C, including comments from aircraft operators; foreign and domestic aircraft and aircraft engine manufacturers; and aviation trade/industry associations. The FAA also recognizes the public concern for aircraft noise problems expressed in response to other recent FAA regulatory actions and has considered those views to the extent that they are relevant to the issues involved in this amendment.

The issues focused on by commenters included: alternatives to the proposed rule that may be available; the impacts of the proposed acoustical change requirements and noise limits (including costs versus benefits, economic reasonableness, technological practicability, compliance dates, the need for tradeoffs and thrust cutbacks, and the appropriateness to particular aircraft types); conformity with international standards; and other miscellaneous issues. These comments are discussed as follows.

IMPACT ON THE PUBLIC

Private citizens, citizens' groups, Federal, State, and local authorities, and airport operators and proprietors have stressed the need for present, as well as future, aircraft noise reduction requirements. The noise of transport category large airplanes and turbojet-powered airplanes was cited, in many comments in response to FAA regulatory proposals, as a principal target for such reductions. Those comments have assisted the FAA in determining that, after due consideration of all comments, the economic impacts imposed are reasonable and appropriate in relation to the benefits to be achieved. The FAA agrees that technology must be applied in the further reduction of noise and those aircraft. This amendment, in conjunction with Amendment 36-7, accomplishes that result consistent with the considerations listed in § 611(d) of the Act.

ALTERNATIVES TO THE PROPOSED RULE

Commenters to this and previous rule-making dockets have expressed their support for the goal of aircraft noise reduction or, more generally, the need for appropriate action to abate the impact of noise annoyance in the airport environment. In responding to the issues involved in the proposals contained in these notices, many commenters recognized the broader issues of aircraft noise control going beyond source noise reduction and discussed the various methods which may be used to achieve noise relief and reduce noise impact on the community. A discussion of those alternatives is contained in the preambles to Amendments 91-136 and 36-7.

Several commenters suggested the adoption of the aircraft noise standards adopted by the ICAO Committee on Aircraft Noise (CAN) at its fifth meeting (CAN V) in late 1976. As previously indicated, the proposals in Notice No. 75-37C were based on the changes to ICAO Annex 16 recommended after CAN IV by Working Group D of that committee. The FAA reviewed in considerable detail the recommendations of Working Group D and supported their adoption at CAN V. The FAA concluded that these recommendations represented appropriate and achievable levels of noise reduction consistent with § 611 of the Act. The adoption of these recommendations by CAN and the FAA would have provided the desirable international uniformity in aircraft noise standards. However, at CAN V, some slight relaxations to the recommended standards were eventually accepted by the committee in the modifications to Annex 16 which it adopted. After a thorough review of the differences involved, the FAA concludes that it should adopt the proposals contained in notice No. 75-37C, since they are in conformity with the purposes and requirements of the Noise Control Act of 1972 and yet achieve a significant level of conformity with the changes to Annex 16 that were adopted.

STAGE 2 ACOUSTICAL CHANGE RULE

As stated in the preamble to Notice No. 75-37, in proposing to establish reduced noise level standards, the FAA considered the fact that a new airplane design generally is "grown" over its lifetime, by increasing its capacity, its range, or both. While each results in an increased public transportation capacity, it usually also involves an increase in aircraft weight and reduced climb performance. This, in turn, may lead to the need for increased thrust and the potential of increased noise levels. These changes in the aircraft design that create potential noise increases are called "acoustical changes."

Notice No. 75-37C proposed, and this amendment adopts, revised requirements for acoustical changes for Stage 2 airplanes for which application is made on or after October 28, 1976. This amendment prohibits the escalation of noise levels of the affected aircraft above those that the FAA has determined are consistent with the purposes and requirements of § 611 of the Act in providing protection to the public health and welfare.

After careful review of the acoustical change requirements proposed in Notice No. 75-37 and of the economic and technological impacts identified in the comments and the supporting data submitted to the docket, the FAA determined that it should not adopt, as part of Amendment 36-7, the major portion of those Stage 2 airplane acoustical change requirements proposed in Notice No. 75-37. Further review and consideration of the overall Stage 2 airplane acoustical change requirements question in light of the alternative proposal contained in Notice No. 75-37C was believed necessary to ensure that those requirements that are adopted are consistent with the purposes and requirements of the Noise Control Act of 1972.

This amendment adopts, in modified form, the acoustical change requirements for Stage 2 airplanes proposed in Notice No. 75-37C. These requirements apply to a Stage 2 airplane for which an application for acoustical change is made on or after October 28, 1976, and for which the type design change is approved after the effective date of this amendment. Under the rule as adopted herein, an airplane that is not powered by turbojet engines or by low bypass ratio turbojet engines (engines having a bypass ratio of less than 2, including pure jets) must comply with the acoustical change provisions for Stage 2 airplanes adopted in Amendment 36-7 (§ 36.7(d)(2)). Thus, those airplanes are treated under this amendment in the same manner as Stage 2 airplanes under the acoustical change rule adopted in Amendment 36-7; they are restricted to noise level increases by the Stage 2 noise limits. A Stage 2 airplane powered by high bypass turbojet engines (engines having a bypass ratio of 2 or greater) may not exceed either (i) any Stage 3 noise limit by more than 3 EPNdB or (ii) any Stage 2 noise limit, whichever is lower.

Comments received in the docket were generally favorable regarding the substance of the acoustical change requirements for Stage 2 airplanes. Commenters strongly supported a rule that would achieve the greatest possible degree of consistency with ICAO Annex 16, even if they did not agree with all aspects of the standards. As previously stated, the FAA agrees that substantial conformity among the various national and international aircraft noise standards is desirable.

Many of the commenters urged the FAA to adopt standards identical to those which were adopted at the ICAO CAN V meeting, even though those standards differ somewhat from those proposed by the FAA. Those commenters felt that international uniformity in aircraft noise requirements is essential to avoid severe and unjust economic penalties for some, and confusion for all who are involved in aviation. The FAA does agree that, while uniformity is desirable, the FAA's duties and responsibilities under § 611 of the Act should not be compromised in order to achieve uniform international aircraft noise standards.

The proposals in Notice No. 75-37C to which commenters expressed concern primarily involved the proposed amendments to Stage 3 noise limits and the applicability dates for the requirements. While the Stage 2 acoustical change rule adopted in this amendment is related to both of those matters, each is discussed below under separate headings. One commenter also objected to the possible increased stringency of the acoustical change requirements for airplanes that have already shown compliance with Part 36 noise levels ("Stage 2 airplanes"). The commenter contended that adoption of requirements more stringent than those in effect when the airplane was certificated could seriously and unfairly impede the full realization of the planned-for growth of the airplane type and, thereby, deny a justified economic return on that design type. The FAA disagrees, since it has reviewed the economic and technological aspects of the proposal and concludes that the amendment, as adopted, is economically reasonable and technologically practicable as applied to the affected aircraft. The FAA also conclues that the additional limitation on noise level increases for Stage 2 airplanes adopted in this amendment is adequately supported by the experience under the current acoustical change rule. The FAA has reviewed the details of comments and supplementing data submitted to the docket regarding Stage 2 acoustical proposals in light of the consideration of § 611 of the Act. The FAA concludes: (1) that a firm and potentially lower noise limit applicable to type design changes of airplanes that have been shown to comply with Stage 2 noise limits is needed, and (2) that the acoustical change rule for Stage 2 airplanes adopted by this amendment is economically reasonable, technologically practicable and appropriate to the aircraft to which it applies. Accordingly, this amendment adopts the Stage 2 acoustical change rule proposed in Notice No. 75-37C.

STAGE 3 NOISE LEVEL STANDARDS

This amendment adopts modifications to the interim noise limits adopted in Amendment 36-7 to ensure that currently achieved noise reductions are preserved and that future aircraft types more fully utilize available noise suppression technology. This amendment is a complement of the initial noise level reduction adopted in Amendment 36-7 and prescribes the alternative standards proposed in Notice No. 75-37C. It also corrects and clarifies the applicability provisions under § 36.201 adopted in Amendment 36-7.

Many commenters addressed the Stage 3 noise limits proposed for airplanes for which application for type certification is made on or after November 5, 1975. A discussion of many of those comments is contained in the preamble to Amendment 36-7. Other comments more specifically addressed the alternative noise level requirements proposed in Notice No. 75-37C and adopted in this amendment.

After carefully reviewing the economic and technological aspects of the proposed rule in light of comments and supporting data submitted to the docket, as well as other available economic and technological data, the FAA concludes that a modification of the noise limits adopted in Amendment 36-7 is appropriate. Thus, the noise limits adopted in this amendment reflect a refinement of the noise limits for the different classes of aircraft consistent with the scope of Notice Nos. 75-37, 75-37B, and 75-37C and with the considerations of § 611 of the Act. Under this amendment § C36.5(a)(3) is revised to prescribe Stage 3 noise limits separately for take-off, sideline, and approach noise as follows:

1. For takeoff noise, the distinction based on the number of engines that was adopted in Amendment 36-7 is retained. Additionally, the noise limits at the lower aircraft takeoff weights are reduced 1 EPNdB for airplanes with three or more engines. Thus, the noise limit for all Stage 3 airplanes at or below the prescribed maximum weights is 89 EPNdB. The noise limits at the higher takeoff weights remain at (1) 106 EPNdB for airplanes with more than three engines, (2) 104 EPNdB for airplanes with three engines, and (3) 101 EPNdB for airplanes with fewer than three engines.

2. For sideline noise, the distinction among aircraft based on the number of engines contained in the interim limits is eliminated. The interim noise limits for Stage 3 airplanes with three engines and with more than three engines are reduced to coincide with the limits adopted in Amendment 36-7 for airplanes with fewer than three engines. Under this amendment, the noise limit is prescribed at 94 EPNdB for maximum weights of 77,200 pounds or less; the limit is increased by 2.56 EPNdB for each doubling of the 77,200 maximum weight up to the noise limit of 103 EPNdB for maximum weights of 882,000 pounds or more.

3. For approach noise, a refinement of the noise level requirements (regardless of the number of engines) was proposed in Notice No. 75-37C and is adopted in this amendment. Thus the noise limit of 105 EPNdB at the maximum weights of 850,000 pounds or more is applied to airplanes with maximum weights of 617,300 pounds or more; the noise limit of 98 EPNdB for the maximum weights of 75,130 pounds or less is applied to airplanes with maximum weights of 77,200 pounds or less; and the interim rate of noise reduction for each halving of the 617,300 pound maximum weight is increased from 2 ENPdB to 2.33 EPNdB.

In connection with the Stage 3 noise standards proposed in Notice No. 75-37, many comments suggested that the FAA adopt the noise standards for new airplane types then being recommended by CAN Working Group D for adoption by the ICAO Committee on Aircraft Noise (CAN). The FAA acknowledged that position when it adopted interim Stage 3 noise standards in Amendment 36-7 and indicated that it would consider further amendments to those noise standards based on Notice No. 75-37C (ICAO CAN Working Group D recommendations) under § 611 of the Act.

In that regard, independent FAA and ICAO member state reviews of the economic and technological considerations of the overall noise limits for new type design (Stage 3) airplanes indicated that the standards proposed in Notice No. 75-37C would more fully accomplish the objectives of § 611 of the Act. Thus, the FAA stated that it believed that the noise standards subsequently issued in Amendment 36-7 should be further amended if, after further consideration in the light of comments then being submitted to the regulatory docket, no significant contrary data, views, or arguments were presented. Particular attention has been given to the proposed approach noise limits since economic and technological considerations under § 611 of the Act support refinements to those standards which involve small noise limit increases for some maximum weights together with decreases for some other weights. The unperceivable changes in noise levels involved are reflected in the increase from 2 to 2.33 EPNdB in the rate of noise reduction for each halving of maximum weight and related adjustments to the weight component in the noise limit formula described above.

As previously stated, most commenters urged the FAA to adopt aircraft noise standards that represent the greatest possible uniformity with international standards. While there

are some differences between the proposals in Notice No. 75-37C and the changes to ICAO Annex 16 subsequently adopted at the CAN V meeting, the FAA concludes that this amendment substantially achieves the conformity addressed by the commenters. The experience gained in the noise certification of new aircraft types by the FAA and ICAO supports the noise limits proposed in Notice No. 75-37C. Economically reasonable and technologically practicable means are available to achieve those noise limits without unduly inhibiting the reasonable development of new aircraft type designs and with sufficient latitude for subsequent growth of those aircraft. Thus, the FAA does not agree with those commenters who suggested relaxations of the noise standards to levels above those proposed in the supplemental notice.

Before adopting this amendment, each component factor of aircraft design in relation to noise emission was considered in relationship to the applicability and stringency of the noise standard, as well as the consistency of the standard with the purpose and requirements of the Noise Control Act of 1972. Accordingly, this amendment adopts, in modified form but without substantive change, the noise standards proposed in Notice No. 75-37C. In addition, this amendment corrects the language in § 36.201, which describes the applicability of noise limits under Appendix C, to apply those limits to airplanes powered by engines other than turbojet engines as discussed in the preamble to Amendment 36-7. Notice No. 75-37 proposed, and the preamble to the amendment stated, that the FAA intended to apply the Appendix C noise limits to subsonic transport category large airplanes and to subsonic turbojet powered airplanes. The FAA did not propose or intend to revoke any of the substance of the applicability provisions. However, contrary to the proposed rule and the nature of the amendment described in the preamble to the amendment, the amended text of § 36.201 published in Amendment 36-7 inadvertently omitted some of the words of applicability. Thus, this action includes the necessary corrective and clarifying amendment to § 36.201 by revising the headings to paragraphs (b) and (c) and amending the introductory clause under paragraph (c).

NOISE MEASURING POINT AND TEST REQUIREMENTS

Notice No. 75-37C proposed to amend § C36.3(c) to modify the takeoff, sideline, and approach noise measuring point distances. It also proposed to amend § C36.7(b) to provide separate provisions and different requirements governing the altitudes during takeoff noise tests above which power or thrust may be reduced (minimum cutback altitude). Adoption of those proposals in this amendment brings Part 36 into greater conformity with ICAO Annex 16. Comments received regarding these proposals were generally favorable.

Several commenters pointed out that adoption of the proposed minimum cutback altitudes for future versions of Stage 1 and Stage 2 airplanes, as well as for Stage 3 airplanes, could result in some relaxation of the takeoff noise standards. The takeoff noise measurement before the change in type design under the current rule permits a cutback at a specified altitude (700 feet or 1,000 feet, depending on the number and type of engines). Noise measurement after the change in type design under the proposal would generally permit a cutback at a lower altitude (689 feet, 853 feet, 984 feet, or 1,000 feet, depending on the number and type of engines). Thus, in some cases, the measured noise level after the change in type design could be somewhat different from that measured for the aircraft before the change in type design, due primarily to the change in the minimum cutback altitude. However, in proposing the amendment to § C36.7(b), the FAA did not intend to alter the basic comparability of noise measurements before and after a change in type design of Stage 1 and Stage 2 airplanes. The FAA concludes that the proposed minimum cutback altitudes are supported by the available data for Stage 3 airplanes with turbojet engines but that there is no compelling reason for not preserving the comparability of noise measurements for Stage 1 and Stage 2 airplanes or applying the amended altitudes to Stage 3 airplanes not powered by turbojet engines. Accordingly, this amendment adopts the proposal only for Stage 3 airplanes with turbojet engines and § C36.7(b) is revised to provide the appropriate applicability provisions.

While several commenters had some reservation regarding the proposed amendment of the sideline noise measuring point in § C36.3(c), they felt the necessity of conformity in international aircraft noise standards overrode their objections. The FAA also concludes that for uniformity of application the noise measuring distances and related specifications adopted in this amendment should be applied to all noise tests conducted after the effective date of this amendment. The FAA does not believe that the comparability of noise measurements made before and after a change in type design for the affected Stage 1 or Stage 2 airplanes is significantly affected by those amendments. A review of the anticipated effects of the changes in the measuring point distance indicated that the distances of the airplane from the measuring stations would not be significantly increased and that the minor increase in distance would have a negligible impact on the measured noise levels. The nominal differences in measured noise levels that may result at the amended measuring points do not justify making the rule more complex by prescribing separate measuring points for different stages of aircraft. Accordingly, this amendment adopts the changes to § C36.3(b) proposed in Notice No. 75-37C.

The FAA has reviewed those proposals in conjunction with the proposed noise level limits adopted in this amendment and concludes that the amendments to the minimum thrust or power cutback altitudes (§ C36.7(b)) and to the noise measuring point distances (§ C36.3) and related aircraft height specification (Appendix A) are in conformity with the requirements of § 611 of the Act. The primary purposes for these amendments are to achieve appropriate levels of noise reduction under § 611 of the Act and greater conformity with the international aircraft noise standards under ICAO Annex 16. It is noted, however, that more stringent requirements regarding the takeoff test conditions provisions in § C36.7 and noise measuring points provisions in § C36.3 are currently under consideration by the FAA. Those proposals are part of the recommended regulation submitted to the FAA by the EPA and published in Notice No. 76-22. Accordingly, the provisions adopted in this amendment may be amended further after consideration of the EPA proposals in accordance with § 611(c)(1) of the Act. These amendments do not imply any particular final action that may be taken regarding the EPA proposals after they have been fully considered under the prescribed procedure.

ECONOMIC COMMENTS

Some commenters to the regulatory docket expressed concern for the economic impacts of the proposals. In addition to the comments already discussed, the commenters concentrated primarily on the proposals in Notice No. 75-37, regarding the cost impacts of the originally proposed Stage 2 acoustical change rule and the Stage 3 noise limits and acoustical change requirements. Commenters were generally more favorable regarding the impacts of the specific alternative proposals in Notice No. 75-37C. The FAA has fully reviewed those comments and relevant factors and concluded that the regulation adopted in this amendment adequately and properly accounts for the cost impacts involved. Economically reasonable noise reduction technology is available for the affected airplanes. The compliance/ap-

plicability dates of the provisions of this amendment require application of currently available noise reduction technology at the earliest date that is economically reasonable and consistent with the significant and enduring impacts upon the noise abatement benefits the rules are intended to achieve. Deferring the effectivity of the amendments (as suggested by some commenters), and, thus, the environmental benefits, would not be in the public interest or consistent with the FAA's responsibility under the Noise Control Act of 1972 to provide current and future relief from aircraft noise through appropriate noise control and abatement regulations.

As previously discussed, the major concerns for the cost impact addressed by most commenters focussed upon the costs involved in applying the proposed further limitations on the growth versions of Stage 2 airplanes already certificated under Part 36 and in production. Many commenters stated in effect that, since the economic viability of an airplane design program depends in significant measure on the ability to modify the basic design at various times during the life of the aircraft, the proposed rules might not permit the full realization of planned-for growth. According to some commenters, those restrictions, particularly those proposed in Notice No. 75-37, would be economically unreasonable and could have far-reaching economic implications for the aviation industry and the national and international air transportation systems. The FAA has considered the reasoning and views of these comments in light of all matters presented and concludes that it should adopt the proposed alternative Stage 2 acoustic change rule at this time.

The cost impacts resulting from this amendment are associated with its effect upon (1) the Stage 2 aircraft for which acoustical change approvals are applied for on or after October 28, 1976, and (2) the Stage 3 aircraft for which type certification is applied for on or after November 5, 1975, or for which acoustical change approvals are applied for on or after May 5, 1976. As noted by commenters (and discussed in the EIS for Amendment 36-7 and the economic analysis in the NED for this amendment) the identified costs of the rule include those in the following three general categories: (1) Investment costs for the development of a new technology airplane which will comply with the new noise levels; (2) changes in the direct operating costs for the new technology airplanes, including costs due to changes in weight, fuel consumption, and performance as a result of design parameters required to meet the reduced noise levels; and (3) lost productivity arising from decreased payload or range capabilities due to design parameters. The FAA has reviewed cost information and data available to it. Manufacturers of aircraft and aircraft engines were requested to provide the necessary additional data which would be used to consider the economic reasonableness of the proposed rule. The FAA has considered that information and data which were submitted.

The FAA agrees with commenters who noted that the proposed noise standards are not so stringent as to make them economically unreasonable or not technologically achievable at this time. The FAA believes, further, that the recent review of aircraft noise levels by ICAO supports this view. While some commenters recommended that the noise limits should be either significantly higher or lower in certain weight and number of engine combinations, the FAA concludes that the noise limits adopted in this amendment reflect the appropriate modification of the noise standards and are consistent with the purpose and the requirements under § 611 of the Act.

Applicability Dates

Comments were received which suggested that the rule, if adopted, should be restated to clearly indicate that the Stage 3 provisions apply only to future aircraft not already certificated. As discussed in the preamble to Amendent 36-7, the proposed rule does not apply to type certificates which already have been issued or to acoustical changes which already have been approved. The prescribed compliance dates for both type certification and acoustical change approvals are governed by the date the application is made. For example, the Stage 3 noise limits apply to airplanes for which an application for a type certificate is made on or after November 5, 1975 (the publication date of Notice No. 75-37 which proposed to reduce the noise limits); similarly, the Stage 2 acoustical change provisions apply to Stage 2 airplanes for which an application for an acoustical change approval is made on or after October 28, 1976. In that regard, some commenters also objected to what they viewed as enforcing the proposed amendment "retroactively" to applications filed before the issuance of the final rule, or before thirty days after publication of the final rule. One commenter suggested an applicability date six months after publication. As stated in Notice No. 75-37, and in the preamble to Amendment 36-7, "while certain of the proposals specified herein would apply to applications that are made on and after the date of this NPRM (but before the effective date of the final rule), none of these proposals would affect approvals that are actually issued prior to the effective date of the final rule." That form of applicability date has been proposed and adopted before in amendments to Part 36 when the FAA was concerned with the timing of the effective date of proposed rules because of the significant and enduring impact upon the noise abatement benefits the rules are intended to achieve. Thus, the FAA proposed to apply these proposals to applications made on or after a specified date related to the date of publication of the notice. By adopting that part of the proposals, the FAA avoids the possibility of a significant number of applications being submitted in anticipation of the effective date of the final rule but for which issuance or FAA approval could not occur before the rule becomes effective (or for years after the rule becomes effective, since applications for certain type certificates do not expire for five years after they are filed). In effect, the notice announced that it was the FAA's intention to apply the amended rules, if adopted, when they became effective, to certifications and approvals even though the application was received during the period between the publication date of the notice and the effective date of the amended rule. The FAA has concluded that, in those cases, the applicable rules should be those in effect on the date of certification or approval, not the date of application for type certification or acoustical change.

Miscellaneous Comments

A number of comments contained views regarding other aspects of the proposals. Many of those comments involved subjects or issues which are beyond the scope of Notice Nos. 75-37, 75-37B, or 75-37C. To the extent that those comments provided information which is relevant to this regulatory action, those comments have been considered in adopting this amendment. FAA's responses to some of those comments were contained in the preamble to Amendment 36-7 and are not repeated here.

Several comments were received from commenters who felt that the proposed rule changes to Appendices A and B of Part 36 contained in Notice No. 76-21 (41 FR 47342; Oct. 28, 1976) regarding the procedures and conditions for conducting noise tests and evaluating noise test data, might have a significant impact on their comments regarding the proposed noise levels and acoustical change requirements since such things as basic design parameters may be affected. Some of those commenters stated that they were concerned that amendments to the noise test procedures and conditions may significantly increase the stringency of the noise limit proposals. As indicated in Notice No. 76-21, the anticipated impact of the noise test proposals does not involve any significant increase or decrease in the result-

ing noise level measurements but would contribute substantially to improving the consistency and repeatability of noise data under the proposed requirements.

As stated in the preamble to Amendment 36-7, the FAA recognizes the interaction between noise test methodology and the noise level measurements which result. While no significant change is expected from the proposed amendments to Appendices A and B, the FAA is considering the potential of those impacts in reviewing the proposals and comments to the docket before taking any final action regarding Notice No. 76-21.

Several comments suggested that separate rules should be adopted for turbojet powered airplanes weighing less than 90,000 pounds and another for propeller-driven transport category large airplanes. The rationale presented was that the noise emission characteristics and noise reduction technologies for those airplanes are distinguishable and should be treated separately from the larger turbojet powered airplanes. Comments also stated that, since there has been no recent Part 36 certification experience with propeller-driven large transport category airplanes, the available economic and technological data do not exist to support the proposed noise level reduction rule with regard to those airplanes. As stated in the preamble to Amendment 36-7, the FAA agrees that for some regulatory purposes those classes of aircraft could receive separate treatment. However, the FAA does not agree that, for noise control purposes, the rationale offered in the comments compels separate rules or regulatory action for those classes of aircraft. A full and careful consideration has been given to the aircraft design factors that may tend to distinguish among the various airplane types affected by the amendments.

Thus, the noise level standards adopted in these amendments apply to transport category large airplanes, including turbo-prop and other propeller-driven aircraft, as well as to subsonic turbojet powered airplanes, regardless of category. Although the FAA anticipates that most, if not all, of the aircraft that are certificated under the standards adopted in these amendments will be turbojet (including turbofan) powered, the FAA has concluded that the reductions are also appropriate to current technology propeller-driven large airplanes. However, the FAA notes that the potential exists for transport category airplanes to employ advanced propulsion systems that are neither turbojet (including turbofan) nor conventional propeller/engine combinations. Progress in those developmental programs will be monitored closely to determine whether improved regulations are necessary.

The FAA concludes that, based upon its review of the best available noise reduction technology and the cost impacts of requiring its application on all new type designs, this amendment, including the extent to which it applies to turbojet powered airplanes weighing under 75,000 pounds and to transport category airplanes regardless of the type of engine, is consistent with the purposes and requirements of § 611 of the Act.

Effective Date

Since further rule-making action regarding certain aspects of the amendments being adopted was contemplated when Amendment 36-7 was issued, the FAA considered whether that amendment should be promulgated before the regulatory procedures on Notice Nos. 75-37C and 76-22 had been completed. As previously indicated, the FAA concluded that the benefits achieved under that amendment should not be deferred until that later date. The FAA believed that, since that amendment prescribed new standards for new type designs and acoustical changes, its early publication would provide aircraft manufacturers and operators a better opportunity to consider those standards, and proposed standards still under consideration, in their design and acoustical change planning. The FAA recognized that while such planning is necessary, its regulatory action must be consistent with its responsibilities under § 611 of the Act. Accordingly, the FAA issued Amendment 36-7 and continued to consider additional proposed rules which would alter, in certain areas, the stringency of those interim standards being adopted; it also delayed the effective date of Amendment 36-7 until October 1, 1977, by which time supplementary amendments based on Notice Nos. 75-37, 75-37B, and 75-37C were expected to have been issued. However, completion of the rule-making process, including consideration of comments to the docket and promulgation of those amendments, took somewhat longer than the original estimates. The FAA considered amending the effective date of Amendment 36-7 to coincide with the effective date of this amendment, but concluded that further postponement of the interim standards for noise reduction that it had already determined should be adopted was not warranted. Accordingly, the FAA proceeded to consider and adopt this amendment with the objective of making it effective as soon as practicable after October 1, 1977. During the interim, the FAA encourages voluntary efforts to meet, or exceed, these amendments and thereby minimize any future compliance in having demonstrated compliance with slightly different standards which are effective only for a short period of time.

For the reasons stated in response to comments on the subject, the compliance/applicability dates adopted by this amendment are those proposed in the notices. The Stage 3 noise limits adopted in § C36.5(a)(3) apply to applications for type certificates made on or after November 5, 1975, and to applications for acoustical change approvals for Stage 3 airplanes made on or after May 5, 1976. The Stage 2 acoustical change rules adopted in § 36.7(d) apply to applications made on or after October 28, 1976. The remaining provisions regarding noise measuring points and minimum power/thrust cutback altitudes become effective and require compliance on and after the effective date of this amendment.

Evaluation of Impacts

Under the regulatory reform policies of the Secretary of Transportation and the Administrator, a comprehensive evaluation of the impacts of this amendment has been completed. In addition to the regulatory impacts previously discussed, the details of that analysis are shown in the environmental assessment statements for Amendment 36-7, and for this amendment. These analyses considered not only the noise reduction benefit, but also the achievement of other significant national objectives, including energy conservation through improved fuel efficiency, improved engine performance for the aircraft mission, improved engine emission levels, and advantages to the consumer of the more advanced aircraft design and lower operating costs despite the effect of modifications to achieve noise reduction.

Based on forecasted aviation growth, the airport noise problem is expected to remain serious despite the introduction of quieter aircraft. For example, between 1975 and 1990, annual air carrier operations have been forecast to increase from 10 million to 16 million, creating additional noise exposure events that, without Federal action such as this amendment and FAR Amendment 91-136, could seriously retard the benefits of the reduction of noise resulting from an introduction of quieter airplanes. The recent economic trends have brought into question certain aspects of the projected substantial growth in airline traffic. Even in light of the recently adopted requirement to retrofit or retire by 1985 certain turbojet airplanes that have not previously been shown to comply with original Part 36 noise standards, the extent to which new aircraft types will be introduced in response to the requirements of FAR Amendment 91-136 is unclear. However, as stated above, it is hoped that Amendment 36-7, together with this amendment, will create strong incentives for the development of a new generation of airplanes markedly

quieter than the noise limits in original Part 36. In summary, the noise reduction is expected to remain small in terms of actual community annoyance until the aircraft fleets include a significant number of Stage 3 airplanes.

The FAA has compared the noise limits adopted in this amendment with the measured noise levels for aircraft certificated under original Part 36. That comparison revealed that some aircraft using the best currently available technology already meet the Stage 3 levels. The available technology permits manufacturers to trade off noise and emission requirements against direct operating cost factors in a manner most appropriate for the aircraft type. Thus, the effect of this amendment is to preserve noise level reductions already achieved by some existing airplane types and to provide the standards and incentives for the introduction of newer and quieter types.

The estimated cost impact of the Stage 2 acoustical change rule is based on its increased stringency for future growth versions of existing aircraft types. This impact was studied under a recently completed contract between the National Aeronautics and Space Administration and Lockheed. The study is discussed in the Negative Environment Declaration (NED) issued in conjunction with this amendment. The study involved the changes required to achieve improvement in the existing performance of aircraft, the associated penalties, and the potential use of mixed flow nozzle technology. A program for developing acoustic nacelles was also considered. The estimated aggregate fleetwide costs for Stage 2 airplanes affected by the acoustical change rule adopted in this amendment would range from approximately $16 to $25 million annually, with initial development costs of approximately $96 million spent over the years development occurs. The projected cost impact of a new technology aircraft designed to meet Stage 3 noise limits as compared to the same aircraft designed to meet Stage 2 noise limits is estimated to represent an approximate increase of 0.1 percent in direct operating costs and a 0.4 percent reduction on return of investment. For each Stage 3 airplane, those costs would amount to a minimal increase over those involved in Amendment 36-7 which were estimated at approximately $330,000 for the largest aircraft and proportionately less for lighter, smaller aircraft. The FAA estimates the aggregate cost during any 7-year period under Amendment 36-7 and this amendment would be less than $100 million. The actual projected costs and offsetting economic benefits analysed in the EIS and the NED in accordance with FAA Order 1050.1B demonstrate the economic impacts of the overall noise reduction. Those impacts have also been evaluated in accordance with OMB Circular A-107 and DOT Order 2050.4. From the evaluation conducted for this amendment, it was determined that it would not significantly increase costs to the private sector, to consumers, or to Federal, State, or local governments. Accordingly, the FAA concludes that the cumulative impact of this amendment is not inflationary in nature and is not a major proposal for which an economic impact statement is required.

The FAA also reviewed the anticipated impact of this amendment of energy consumption. A discussion of that review is presented in the NED. In summary, this amendment could result in a change of less than 1 percent in fuel consumption by the affected aircraft over that of the same aircraft if the amendments were not adopted. Considering the small portion of the civil aircraft fleet affected by this amendment, the anticipated impact represents a negligible change in terms of overall energy consumption.

Drafting Information

The principal authors of this document are Richard Tedrick, Office of Environmental Quality, and Ronn E. Harding, Office of the Chief Counsel.

Adoption of the Amendment

Accordingly, Part 36 of the Federal Aviation Regulations (14 CFR Part 36) is amended, effective April 3, 1978, as follows:

Subpart A—General

1. By amending § 36.7 in the heading and introductory clause in paragraph (d)(2) and by adding a new paragraph (d)(3) to read as follows:

§ 36.7 Acoustical change: Subsonic transport category large airplanes and subsonic turbojet powered airplanes.

* * * * *

(d) *Stage 2 airplanes.* * * *

(2) *Applications on or after November 5, 1975, and before October 28, 1976.* For an airplane for which an application for acoustical change approval is made on or after November 5, 1975, and before October 28, 1976—

* * * * *

(3) *Applications on or after October 28, 1976.* For an airplane for which an application for acoustical change approval is made on or after October 28, 1976, the following apply:

(i) *Airplanes with high bypass ratio turbojet engines.* For an airplane that has turbojet engines with a bypass ratio of 2 or more before a change in type design—

(A) The airplane after the change in type design may not exceed either (*1*) the Stage 3 noise limit by more than 3 EPNdB, or (*2*) the Stage 2 noise limit, whichever is lower; and

(B) During the takeoff and sideline noise test conducted before the change in type design, the quietest airworthiness approved configuration available for the highest approved takeoff weight must be used.

(ii) *Airplanes that do not have high bypass ratio turbojet engines.* For an airplane that does not have turbojet engines with a bypass ratio of 2 or more before a change in type design, compliance must be shown under the requirements of paragraphs (d)(2) (i) and (ii) of this section.

2. By amending § 36.201 by revising the headings of paragraphs (b) and (c) and the introductory clause under paragraph (c) to read as follows:

§ 36.201 Noise limits.

* * * * *

(b) *Airplanes with high bypass ratio turbojet engines.* * * *

(c) *Airplanes that do not have high bypass ratio turbojet engines.* For airplanes that do not have turbojet engines with a bypass ratio of 2 or more, the noise limit requirements are as follows:

* * * * *

Appendix A [Amended]

3. By amending Appendix A as follows:

(a) In each provision and table in which the takeoff noise measuring point distance appears, by deleting the distance "3.5 nautical miles" and substituting for it the distance "21,325 feet (6,500 meters)";

(b) In each provision and table in which the approach noise measuring point distance appears, by deleting the distance "1.0 nautical mile" and substituting for it the distance "6,562 feet (2,000 meters)";

(c) In each provision and table in which the sideline noise measuring point distance appears, by deleting the distance "0.25 nautical miles" and substituting for it the distance "1,476 feet (450 meters)."

(d) In each provision and table in which the aircraft height above the approach noise measuring station ("aircraft approach height") appears, by deleting the height "370 feet" and substituting the height "394 feet"; and

(e) In each provision and table in which the reference approach minimum distance ("NTr") appears, by deleting the distance "369 feet" and substituting for it the distance "393 feet."

Appendix C [Amended]

4. By amending § C36.3 as follows:

(a) In paragraph (a), by deleting the words "3.5 nautical miles" and substi-

tuting for it the words "21,325 feet (6,500 meters)";

(b) In paragraph (b), by deleting the words "1 nautical mile" and substituting for it the words "6,562 feet (2,000 meters)"; and

(c) In paragraph (c), by deleting the words "0.25 nautical miles" and substituting for it the words "1,476 feet (450 meters)."

5. By revising paragraph C36.5(a)(3) to read as follows:

§ C36.5 *Noise levels.*

(a) • • •

(3) *Stage 3* noise limits are as follows:

(i) *For takeoff—*

(A) *For airplanes with more than 3 engines*—106 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 44,673 pounds or less;

(B) *For airplanes with 3 engines*—104 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 63,177 pounds or less; and

(C) *For airplanes with fewer than 3 engines*—101 EPNdB for maximum weights of 850,000 pounds or more, reduced by 4 EPNdB per halving of the 850,000 pounds maximum weight down to 89 EPNdB for maximum weights of 106,250 pounds or less.

(ii) *For sideline*, regardless of the number of engines—103 EPNdB for maximum weights of 882,000 pounds or more, reduced by 2.56 EPNdB per halving of the 882,000 pounds maximum weight down to 94 EPNdB for maximum weights of 77,200 pounds or less.

(iii) *For approach*, regardless of the number of engines—105 EPNdB for maximum weights of 617,300 pounds or more, reduced by 2.33 EPNdB per halving of the 617,300 pounds weight down to 98 EPNdB for maximum weights of 77,200 pounds or less.

6. By revising paragraphs C36.7 (b) and (c) to read as follows:

§ C36.7 *Takeoff test conditions.*

• • • • •

(b) Takeoff power or thrust must be used from the start of takeoff roll to at least the following altitude above the runway:

(1) *For Stage 1 or Stage 2 airplanes*—the following apply:

(i) For airplanes with more than three turbojet engines—700 feet (214 meters).

(ii) For all other airplanes—1,000 feet (305 meters).

(2) *For State 3 airplanes*—the following apply:

(i) For airplanes with more than three turbojet engines—689 feet (210 meters).

(ii) For airplanes with three turbojet engines—853 feet (260 meters).

(iii) For airplanes with fewer than three turbojet engines—984 feet (300 meters).

(iv) For airplanes not powered by turbojet engines—1,000 feet (305 meters).

(c) Upon reaching the altitude specified in paragraph (b) of this section, the power or thrust may not be reduced below that needed to maintain level flight with one engine inoperative, or to maintain a four percent climb gradient, whichever power or thrust is greater.

• • • • •

(Secs. 313(a), 601(a), 603, 611(b), Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421(a), 1423, 1431(b)); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); Title I, National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and Executive Order 11514, March 5, 1970.)

NOTE.—The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Statement under Executive Order 11821, as amended by Executive Order 11949, and OMB Circular A-107.

Issued in Washington, D.C., on February 17, 1978.

LANGHORNE BOND,
Administrator.

[FR Doc. 78-5046 Filed 3-1-78; 8:45 am]

[4910-13]

[Docket No. 16221, Amdt. No. 36-9]

PART 36—NOISE STANDARDS: AIRCRAFT TYPE AND AIRWORTHINESS CERTIFICATION

Aircraft Noise Measurement and Evaluation Specifications

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This amendment updates and clarifies the procedures and standards, including noise measurement and evaluation specifications, for conducting certain aircraft noise certification tests. The amendments are based on developments in the state of the art and on aircraft noise test experience. They are also needed to achieve substantial conformity with modifications to the international noise standards in ICAO Annex 16 recommended by the International Civil Aviation Organization (ICAO) Committee on Aircraft Noise.

EFFECTIVE DATE: April 3, 1978.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION:

REGULATORY HISTORY

On October 28, 1976, the FAA published a notice of proposed rule making (Notice No. 76-21) entitled "Aircraft Noise Measurement and Evaluation Specifications" (41 FR 47342). That notice proposed the amendments to Part 36 described and discussed below. Interested persons were invited to participate in this rule making by submitting written comments to the Rules Docket on the proposals contained in Notice No. 76-21. Based on requests for extension of the comment period, it was extended in a subsequent notice (41 FR 55889; December 23, 1976) to February 28, 1977. All comments received have been given due consideration in the promulgation of this amendment.

Pursuant to § 611(b)(1) of the Federal Aviation Act of 1958, as amended (the Act), the FAA has consulted with the Secretary of Transportation and the United States Environmental Protection Agency (EPA) prior to the adoption of this amendment. A draft final environmental assessment regarding this amendment has been prepared in accordance with the National Environmental Policy Act of 1969, and implementing guidelines and directives. Also, submission of this amendment to the EPA for review and comment prior to its adoption is in accordance with § 309 of the Clean Air Act, as amended (42 U.S.C. § 1857h-7), and the guidelines of the Council on Environmental Quality (40 CFR 1500.9(b)).

DESCRIPTION OF THE AMENDMENTS

The purpose of this amendment to Part 36 of the Federal Aviation Regulations (14 CFR Part 36) is to amend the procedures and standards for conducting aircraft noise type certification and acoustical change tests under Appendices A and B to Part 36, to revise the form by which certain standards and procedures are incorporated by reference in Part 36, and to accomplish editorial changes by designating or redesignating certain provisions, and by providing a table of sections in each appendix to Part 36. This amendment includes specific substantive and clarifying amendments in the instrumentation specifications, calibration procedures, meteorological test conditions, and data correction procedures. As adopted, those amendments apply to Part 36 noise certification tests for transport category large airplanes and turbojet engine powered airplanes conducted on and after the effective date of this amendment. The amendments are based on developments in the state of the acoustic art and on aircraft noise certification experience. They also achieve substantial conformity with the modifications to ICAO Annex 16 recommended by the Committee on Aircraft Noise of the International Civil Aviation Organization (ICAO).

The amendment to Appendix A involves an extensive revision which is accomplished within the general framework of the current appendix. The FAA concludes that some organizational revision is necessary to better accommodate the expanded specifications. However, less extensive amend-

ments are adopted in Appendix B. Certain editorial changes have been made to redesignate certain provisions in Appendices A and B to conform with the style used elsewhere in the Federal Aviation Regulations (FARs). To provide greater ease in identifying and citing the provisions in the appendices to Part 36, this amendment provides a "table of sections" at the beginning of each appendix and designates the respective undesignated provisions of certain paragraphs and sections of Appendix B. Finally, Subpart A of Part 36 is amended by adding a new § 36.6 to prescribe the incorporations by reference contained in Part 36 under 5 U.S.C. 552(a) and 1 CFR Part 51 and to provide the required statements of identification and availability of incorporated published materials. The separate provisions in Appendices A, B, and F, which currently contain incorporations by reference, are amended accordingly.

NEED FOR THE AMENDMENTS

Pub. L. 90-411 and 92-574 were enacted to provide present and future relief and protection to the public health and welfare from noise and sonic boom from civil aircraft. Under these Acts, the Administrator, after consultation with the Secretary of Transportation and the Administrator of the EPA, is responsible for the adoption and amendment of rules which prescribe the necessary standards and regulations. On November 3, 1969, the FAA adopted FAR Part 36 entitled "Noise Standards: Aircraft Type Certification" (34 FR 18355; November 18, 1969). FAR Part 36 contains several appendices in which the technical specifications for demonstrating compliance with Part 36 are prescribed. Appendices A and B to FAR Part 36 contain the specifications for conducting noise type certification tests and for evaluating the noise data in terms of Effective Perceived Noise Level (EPNL). These appendices have been modified only slightly since their adoption in 1969.

COMMENTS AND THE RULE

As previously stated, interested persons have been afforded the opportunity to participate in this rule making by submitting written comments to the public regulatory docket. The period for submitting comments closed February 28, 1977. Those comments received have been reviewed and duly considered in promulgating this amendment.

Eleven commenters submitted comments in response to Notice No. 76-21. Comments were received from an individual private citizen, Federal governmental authorities, foreign governmental bodies and their representatives; aircraft owners and operators; foreign and domestic aircraft and aircraft engine manufacturers; and aviation trade/industry associations.

The issues focused on by the commenters included the technical aspects of the respective proposals, the impact of the noise measurement and evaluation process on the stringency of compliance with the required noise level limits, the practical impact of the proposals on the conducting of noise tests, the economic impact of certain proposals, conformity with international standards, the compliance schedule, and other miscellaneous issues. These comments are discussed as follows:

TEST AND MEASUREMENT CONDITIONS

Proposed § A36.1 would revised the provisions prescribing the conditions under which noise certification tests are conducted and the measurement procedures that are used to measure the noise made by the aircraft for noise tests conducted after March 31, 1977, or 30 days after publication of the final amendment, whichever occurs later.

The FAA proposed to prescribe in a single section all the requirements for an approved test site. While most of the provisions of this proposed section are already contain in Appendix A, it was felt that they should be grouped together. Additional requirements were proposed regarding an independent measurement of sideline noise if test site conditions make simultaneous takeoff and sideline measurements impractical.

A modification of the meteorological specification also was proposed. The temperature and relative humidity conditions under which testing is allowed would be amended to conform with proposed ICAO limits or to adopt a minor variation of the proposed ICAO limits. Basically, those ICAO limits would not allow testing when the sound attenuation rate in the one-third octave band centered at 8 kHz is greater than 12 dB/100 meters. Notice No. 76-21 proposed a limit based on a 10 dB/100 meters sound attenuation rate at the same frequency and an alternative proposal at the 12 dB/100 meters limit. Comments were specifically invited concerning the alternative proposals and the reasons why one sound attenuation rate would be preferable in the test meteorological specification. The FAA stated that it believed that amendments should be adopted to reflect current knowledge and state-of-the-art regarding calculation of atmospheric attenuation of sound energy. Based on its certification experience, the FAA felt that the current weather "window" is too restrictive on some combinations of temperatures and relative humidities while allowing some unsubstantiated corrections in other combinations. The FAA also proposed a new weather specification to require the temperature and relative humidity to be within the "window" from the surface measuring station to the altitude of the aircraft. Under the proposal, more specific restrictions would be placed upon anomalous relative humidity and wind conditions. Each of these proposals grew out of FAA certification experiences and a need to provide regulatory guidance for regulated persons and for use by the FAA regional authorities.

The FAA also stated its belief that to ensure the accuracy of noise level corrections under proposed § A36.11, the requirements for aircraft test weights should be amended to require the takeoff weight to be within five percent of the certification weight and the approach weight to exceed 90 percent of the maximum landing weight.

Several commenters stated that the use of equivalent procedures, including simulated takeoffs and landings, offers several advantages such as wider choice of test sites, expeditious acquisition of test data, and reduced noise and emission pollution at the test site. The FAA agrees that these and other equivalent procedures, when specifically approved by the certificating authority, may facilitate noise certification testing. However, the FAA prefers to control the use of equivalent procedures and assesses each request based on its merits under established policy and guidelines.

Commenters stated that eliminating test points that have obstructions higher than 10 degrees above the ground plane is too stringent. The FAA disagrees. The amendment increases the cone half-angle specification in § A36.1(b)(6) from 75 degrees to 80 degrees (or 10 degrees above the ground plane). The FAA has reviewed the matter and concluded that adoption of the proposal will decrease the impact of obstructions on the measured noise data and increase the uniformity and repeatability of noise tests. Since the increased stringency is reasonable in light of the anticipated benefits and since no supportive technical rationale was presented for retaining the 75 degrees specification, this amendment adopts the increase of 5 degrees in the cone half-angle specification from 75 degrees to 80 degrees.

Several commenters recommended that the FAA adopt the alternative proposal and extend the 8 kHz one-third octave absorption limit in proposed § A36.1(c)(3). The FAA agrees that the limit of 10 dB/100 meters is overly restrictive and is not necessary to preclude unacceptable derogation in the quality of the normalized test data. Thus, the alternative proposal is adopted and the absorption limit is prescribed at 12 dB/100 meters. This amendment conforms to similar action by the ICAO.

Many commenters addressed the proposed meteorological condition specification. Several stated that in general the proposal was too stringent and would add unreasonably to the costs of noise certification. The FAA realizes the impact of the specific restrictions on the applicant imposed by prescribed test-day conditions, including precipitation, temperature, relative humidity, and wind conditions. However, it also recognizes the adverse effects that conditions above the proposed specifications have on the noise test data when they are present between the airplane and the noise measuring station. Thus, the proposed weather conditions are adopted in this amendment to ensure that reliable and representative noise emission data are recorded and are made subject to correction procedures and confidence level requirements.

Several commenters recommended that the wind velocity limits for testing under § A36.1(c) should be relaxed, or eliminated. The FAA does not agree. Since wind conditions above the prescribed limits often affect both the generation of sound and its propagation, thus distorting the measured noise levels, the wind specification is needed to preclude noise data derived under those conditions. That requirement is in the current rule and its amendment was not proposed in the notice.

Another commenter recommended deletion of current and proposed § A36.1(c)(5) dealing with anomalous wind (including turbulence) conditions since the proposed provision is not specific and does not clarify the qualification of meteorological data. The FAA disagrees. That paragraph provides essential limiting factors and guidance to persons involved in aircraft noise certification. Since wind conditions of various kinds may adversely affect measured noise levels, the provision could not practically specify all conditions that would be considered "anomalous." However, if further guidance is found necessary, that information will be developed and made available.

In commenting on the proposed requirements for automatic aircraft position recordings in § A36.1(d), one commenter stated that valid manual methods exist for space position data acquisition, such as a series of synchronized "still" photographs. The FAA agrees. The requirement for automatic recording of aircraft position, as proposed, is not needed and has been deleted in the amendment.

Several commenters stated that various portions of the proposed aircraft testing procedures (§ A36.1(d)) are not needed to increase repeatability (or reduce variability) of test data or to decrease the magnitude of noise corrections. Variability of measured data and the magnitude of corrections of that data to reference conditions can significantly affect the accuracy of noise certification. Based on certification experience, the FAA concludes that the testing standards adopted in this amendment, among other things, substantially reduce the overly broad latitude in the specifications and improve the accuracy and reliability of the noise level computations under the requirements.

Regarding the proposed limits in § A36.1(d) on aircraft weight during noise certification testing, several commenters suggested that the FAA permit a wider range in aircraft test weight than the proposed ±5 percent of maximum takeoff and 90 percent of maximum landing weight. A further suggestion was made to eliminate the proposed requirement to conduct at least one takeoff and one approach noise test at, or above, the maximum weight for which certification is requested. After carefully studying these suggestions, the FAA has concluded that adequate control of aircraft factors can be achieved with takeoff test weights limited between +5 and −10 percent of the maximum weights. However, the proposed requirements for approach noise test weights and for making at least one takeoff and one approach at, or above, the respective maximum weights are appropriate limitations and are, therefore, adopted. Approved data is needed and must be used to determine the variations of EPNL with weight for takeoff and approach test conditions. It is noted that many airplanes burn off fuel at a rate of approximately 1 percent of the aircraft test weight per flyover and as many as 8 or 9 flyovers may be flown for a series of measurements. Thus, it is reasonable to require at least one takeoff and one approach test to be conducted at, or above, the maximum weights for which certification is requested. However, the FAA agrees with those commenters who stated that the limitations on the weight corrections of 2.0 EPNdB is not realistic or needed under the amendment since it adopts the aircraft weight requirements and approved data must be used to determine the variation of EPNL with weight for both takeoff and approach test conditions. Accordingly, the weight correction limitations in proposed paragraphs A36.1(d)(5)(iii) and (d)(7)(iii) are not adopted in this amendment.

NOISE MEASUREMENT SPECIFICATIONS

The measurements prescribed in new § A36.3, like those in prior § A36.2, provide the data for determining the one-third octave band noise produced by aircraft at specific measurement stations, as a function of time. However, the instrumentation performance specifications have been significantly revised over those in the prior rule. These changes incorporate experience with actual certifications by both the FAA and the ICAO.

As stated in the notice, three general guidelines were followed in the preparation of these proposals and considered in their adoption. First, the purpose was to specify both systems and components that would give results with maximum accuracy and repeatability from test-to-test and site-to-site. Second, the proposals were designed to avoid requiring instruments of any single brand name or manufacturer. Third, the specifications prescribe performance requirements that are generally measureable and verifiable in the field, rather than design parameters requiring sophisticated laboratory equipment or technical mathematical analyses. Those specifications enhance compliance by taking greater advantage of readily obtainable FAA approved data and approved manufacturer's specifications.

To achieve these objectives, the rule, as adopted, provides more detailed specifications for microphones (and their accessories), tape recorders, analysis equipment, and calibrators. These revisions are primarily based upon experience with actual certifications and reports of some difficulty in understanding the more general language of the current rule. While the amendments do not substantially change the application of procedures, they prescribe improved or more specific procedures and practices which should result in more uniform and verifiable data. One feature of the amended rule is the introduction of a new paragraph A36.3(e) on calibration. This paragraph requires standardization of both calibration procedures and implementation schedules to provide more uniform and repeatable data by minimizing unaccounted for equipment variability and operator error.

Several commenters suggested clarifications of various aspects of the measurement system, including the sensing, recording reproducing, and analysis equipment. Since the FAA agrees that most of the suggestions clarify the intent and understandability of the provisions, those suggestions have been adopted. It should be noted that system specifications, as proposed and adopted, permit the use of corrections furnished by the equipment manufacturer. In addition, in response to several commenters, that FAA deleted the microphone support component as a part of the combined system for purposes of demonstrating the overall free-field frequency response at grazing incidence. As recommended by several commenters, the provision is also modified to provide two acceptable methods for determining the overall free-field frequency response at 90 degrees (grazing incidence) of the com-

bined microphone (including incidence correction, if applicable), preamplifier, and windscreen. Those methods are (1) the use of an electrostatic calibrator in combination with manufacturer-provided corrections or (2) the use of an anechoic free-field facility.

According to one commenter, an error of 0.3 dB should be allowed between any two settings on attenuators used for range changing. The FAA proposed a 0.1 dB tolerance in § A36.3(b)(6). The commenter stated the relevant IEC specification permits 0.5 dB. FAA review indicated that the 0.5 dB tolerance mentioned was contained in an outdated IEC specification for sound level meters. After reviewing the comment and current industry specifications for noise analyzers, the FAA concluded that it should adopt a specification permitting an 0.2 dB error between any two settings on the attenuators used for range changing. Several commenters also noted the typographical error in the paragraph where the word "integral" appeared instead of the word "interval." This amendment reflects the necessary change.

Some commenters stated that the proposed limits on the magnetic tape recorder in proposed A36.3(c)(3)(ii) were too restrictive. The FAA disagrees. The proposed corrected frequency response specification adopted in this amendment can be met by several currently available types of magnetic tape recorders. The asserted economic burden attributed to requiring the acquisition of new recorders in those cases where it would be necessary has been considered and determined to be reasonable in light of the benefits achieved.

Several commenters suggested that the intent of the calibration specification in § A36.3(b)(4) would be more clearly expressed if the words "in each third octave band" were added to the end of the first sentence. The FAA does not agree that the suggested addition clarifies the technical sense of the provision.

Another commenter stated that the meaning of "pink noise" is not explicit. Since the definition prescribed in § A36.3(e)(i) is widely accepted in acoustic terminology, the FAA does not agree and adopts the definition as proposed.

Several commenters felt that pink noise should be used only for frequency response calibration and that use of a pistonphone is preferable in establishing amplitude response. The FAA disagrees. The defininiton of pink noise and its use to calibrate the specified equipment for both amplitude and frequency response are widely regarded as the technically acceptable and recognized methodology by the acoustics community.

Several commenters stated that certain portions of the proposed equipment requirements in § A36.3(c) would, if adopted, disqualify some "high-quality" and currently acceptable or available commercial equipment. In proposing the requirements, the FAA recognized that some acoustic equipment would be unable to satisfy the more stringent standards. However, since measured data is only as good as the equipment and process used to record and evaluate it, the equipment component of an accurate EPNL computation requires close scrutiny to ensure that it reflects the state of the art. The equipment specifications adopted in this amendment provide considerable assurance that reasonably achievable levels of acoustic accuracy and dependability are provided.

Some commenters also questioned whether the proposed acoustic analysis equipment and calibration requirements (§§ A36.3 (d) and (e)) are appropriate. Several stated the requirements would be overly restrictive, without technical justification, or would eliminate applicant flexibility without sufficiently improving data. The FAA disagrees. Analysis equipment specifications, among other things, provide the means for assuring that the performance of the available quality acoustic equipment required under this amendment is within acceptable margins of its capabilities and achieves the required confidence levels for the data derived through it. While other equipment and procedures are available, some of which were described by commenters, the FAA after reviewing the proposal and available technical information, in light of the comments, concludes that the specifications adopted in this amendment are reasonable and achieve the desired results. In addition, to clarify paragraph (e)(1), the words "as installed in the field," have been added within the parenthetical modifying the complete electronic system. Further, to provide greater flexibility in the systemic calibration schedule, the amendment only requires calibration after the end of a test series which should permit minor deviation from the general five day requirement when circumstances make it necessary and the FAA requires or authorizes otherwise. The last sentence of paragraph (e)(1) reflects that change.

One commenter recommended that the required normal incidence pressure calibration of the microphone/preamplifier system be permitted to be completed within six months before the beginning of each test series. The notice proposed a 30-day requirement for calibration. After considering the purpose of the requirement and in view of the recommendation, the calibration requirement should be relaxed; accordingly, this amendment requires a calibration within 90 days of the beginning of a test series.

Another commenter stated that accountability for tape sensitivity is inherent in FM recording and, therefore, calibration is unnecessary. The commenter also stated that the recording of the calibration signals for a 30-second duration at the beginning and end of each reel of magnetic tape was unreasonable. The FAA feels that for consistency and accuracy in reducing required data, it is necessary to retain the calibration requirement for both AM and FM recording systems. However, after reviewing the proposal and in view of the comments, the FAA concludes that the required calibration signal period should be reduced to a 15-second burst of pink noise at the beginning and end of each reel of magnetic tape. Further, since paragraph (e)(3) requires essentially the same calibration results, redundancy is not needed. This amendment reflects those changes.

One commenter claimed that the total variation requirements of the pink noise test signal levels of 0.5 dB in proposed § A36.3(e)(6) is unreasonable. While it disagrees with that characterization, the FAA notes that the ICAO, in adopting a similar requirement, allows a slightly higher variation—0.75dB. Since this requirement is representative of that achievable for currently available quality equipment, that change is also adopted in this amendment.

In response to proposed § A36.3(e)(7), one commenter recommended permitting the use of any approved random noise generator technique to demonstrate conformity of the one-third octave filters with the recommendations of IEC 225. The FAA agrees. Thus, paragraph (e)(7)(ii) has been rewritten to permit the use of an approved random noise generator technique as an "alternative technique" under the rule.

One commenter recommended that § A36.3(5) require positioning the microphone so that its sensing element provides optimum performance as described by the manufacturer. The FAA disagrees. For the desired results, the microphone should be oriented so that the diaphragm is substantially in the plane defined by the flight path of the aircraft and the measuring station. Two commenters stated that the proposed requirement of recording 20 seconds of ambient noise before and after each measurement is impractical and creates an undue burden. After reviewing the matter, the FAA agrees and concludes that one 10-second recording of ambient noise provides a representative sample of the noise level that existed during the flyover noise measurement. The rule is adopted accordingly.

Another commenter stated that as it appears in § A36.3(f), the word "occasional" before "background noise" was

ambiguous and confusing. The FAA agrees. Paragraph A36.3(f)(4) has been rewritten to delete the word "occasional" which is not necessary in the specification as adopted.

Several other minor editorial changes made in § A36.3 from the proposed text include the following matters. In paragraph (c)(3)(ii), the word "corrected" is added to modify the words "frequency response" to more clearly state that the specification contemplates and permits appropriate corrections before applying the response limitations. As suggested by one commenter to clarify the statement in paragraph (c)(3)(iii), the words "make it necessary" have been deleted and the words "are insufficient to obtain adequate spectral information," are substituted for them. In addition, since all analyzer indicating devices are either analog or digital (or a combination of them), the first sentence in paragraph (d)(3) is restated accordingly.

MEASURED DATA REPORTING AND CORRECTING

Under the § A36.5, as proposed and adopted in this amendment, data representing physical measurements, or corrections to measured data (including corrections to measurements for equipment response deviations) must be recorded in permanent form and appended to the record. The rule requires certain estimates of the individual errors inherent in each of the operations employed in obtaining the final data.

This amendment clarifies the established procedure by expressly providing for a correction of any difference between the test engine thrust or power and the reference engine thrust or power. That correction was proposed in terms of "engine rating"; however, upon review of the proposal and its purpose, the required correction is more correctly stated in terms of "engine thrust or power." This amendment adopts that change from the proposal. Additional standards are also provided for determining the validity of test results when more than one test site is used to demonstrate compliance.

Some commenters felt that the proposed requirement in § A36.5(d)(3) that no more than four one-third octave band SPLs be within 5 dB of ambient at any time within the 10 dB-down points would be unreasonable, particularly for aircraft that produce low noise levels. The commenters stated that the requirement would necessitate extensive on-site analysis to determine whether or not the acquired data were acceptable, and thus, would result in over-use of equivalent procedures. One commenter recommended the use of spectral extrapolation. The FAA has reviewed the matter and concludes that the proposed four band limit is not overly restrictive and that the limit is needed to provide a reasonable and appropriate correction requirement to ensure accuracy and repeatability of data. However, the FAA concludes that provision should be changed to allow correction rather than exclusion of the levels in any frequency band provided the correction is made under an FAA approved method. Spectral extrapolation, which achieves the same results, would be considered for approval as an equivalent procedure under the rule. Thus as adopted, § A36.5(d)(3) has been rephrased to permit corrections under an approved method.

Also, the proposed § A36.5(d)(2) misstated that the correction of source noise must be from approved data for the difference "between measured and corrected engine conditions." That provision is corrected in the amendment to reflect the required correction in terms of the difference "between measured and reference engine conditions."

Several commenters stated that requirement for the 90 percent confidence limit to not exceed ±1.0 EPNdB for each of the three average noise certification levels is not justified. They stressed that although many noise certification tests have been accomplished with 90 percent confidence limits less than ±1.0 EPNdB, a reduction to ±1.0 EPNdB from ±1.5 EPNdB, when combined with the current limitations in on-site normalization capabilities, could impose undue penalties on the applicant. For example, to comply with the ±1.0 EPNdB limit, the applicant may have to incur the costs involved in either conducting additional test runs or keeping the test set-up intact until the data processing confirms compliance within the ±1.0 EPNdB limit. The commenters noted that the impact of such a reduction in the limitation has not been fully evaluated or validated under several significant test conditions. The FAA agrees that the confidence interval of ±1.5 EPNdB should be retained at this time. In the absence of significant experience with the lower limit, it is reasonable to anticipate that its adoption is likely to result in an increased sample size, especially for the sideline noise meansurements.

Two commenters stated that the proposed duration correction fails to account for the effect of any differences in ground speeds between the reference conditions and the certification test conditions. The FAA disagrees. Proposed § A36.5 clearly specified that the aircraft performance data and the noise measurements must be corrected to reference atmospheric conditions which include the zero wind factor.

SYMBOLS AND UNITS

As part of the revision of Appendix A proposed in Notice No. 76-21, current § A36.4 would be redesignated as "§ A36.7." That proposal is adopted in this amendment. However, since the noise measuring point distances and related flight path heights prescribed in Appendix C are amended in Amendment 36-8, this amendment includes the necessary amendments to the symbols and units to achieve conformity.

One commenter correctly noted that the symbol "LX_c" used in proposed § A36.11(d)(3) although defined in that provision is not provided under § A36.7: "Flight Profile Distances." In addition, the FAA notes that for consistency "X_c" should be provided under the "Flight Profile Identification Positions." Accordingly as adopted, § A36.7 includes the meaning of "LX_c", which is the "Corrected Sideline Noise Path", as: "the distance from station L to the corrected aircraft position X_c." "LX_c" is described as "position on corrected takeoff flight path corresponding to PNLTM at station L."

ATMOSPHERIC ATTENUATION OF SOUND

Under the current provisions of Appendix A (§ A36.5), the measured one-third octave band spectra are corrected to the reference-day conditions. Under revised Appendix A (§ A36.9), this correction is amended to better account for the differences in the atmospheric attenuation of sound between the test-day conditions and the reference-day conditions along the entire sound propagation path between the aircraft and the microphone.

As stated in the notice, experience has shown that the measurement of, and correction for, nonreference meteorological conditions are exceedingly critical to obtaining accurate, consistent, and repeatable test results. The FAA has concluded, after reviewing the proposal and comments submitted to the docket, that the proposed detailed meteorological data are needed and should be required. This amendment accomplishes that purpose. Specifically, current (test-time) meteorological observations of the temperature and relative humidity are required over the whole sound propagation path from the aircraft to the noise measuring station. To avoid localized anomalous conditions that often occur near the ground, the surface meteorological measurements continue to be made 10 meters above the surface.

Under the proposal, if the atmospheric absorption coefficients vary over the sound propagation path by more than ±0.3 dB/1,000 feet in the 3150 Hz one-third octave band from the attenuation rate defined by the surface meteorological measurements,

applicants would have been required to base atmospheric attenuation corrections upon the mean attenuation rate for each one-third octave over the entire length of the sound propagation path. However, the absence of inversions in both temperature and relative humidity during compliance testing would no longer be a limiting factor in the test sequence.

In proposing this amendment, the FAA stated its belief that the amendments would provide technologically adequate means for correcting noise data that are obtained under some atmospheric conditions under which testing is prohibited under the current Appendix A. Taken together, the revisions of proposed §§ A36.1 and A36.9 would provide improved measured data and increase the number of days during which tests may be conducted. Except as discussed below, those proposals are adopted in this amendment.

One commenter recommended deletion of the requirement in proposed § A36.9(b)(2) for recording temperature and humidity levels in the vicinity of each microphone location. The FAA disagrees. These data are necessary to insure that existing atmospheric conditions are measured and that adequate corrections are made to achieve equivalence with the reference atmospheric conditions.

Two commenters stated that the requirement to take meteorological measurements every 45 minutes during any test period implied that once the test period began, meteorological measurements must be taken at least every 45 minutes even though test measurements were temporarily discontinued or delayed. The FAA agrees that clarification is necessary. Under the proposal, noise measurements would always occur within 22.5 minutes of a required meteorological measurement. Comparable accountability for potential changes in meteorological conditions during the test period is achieved under the amendment by restating the provision to require meteorological measurements within 25 minutes of each noise test measurement.

As noted by one commenter, the reference to "corrected flight path" in proposed § A36.9(d)(1)(ii) is in error and the provision should refer only to "reference flight paths." This amendment reflects that change.

Several commenters recommended that the limitation on atmospheric absorption coefficients in § A36.9(d)(2) should be consistent with a constant absolute humidity and a standard lapse rate. The FAA does not agree. The prescribed layering correction procedure is to be used when the coefficients vary by more than the prescribed limit. The FAA concludes that the requirement to use the layering correction procedure, in addition to providing consistent and repeatable test results, will permit compliance testing in the presence of inversions which previously precluded the test sequence.

Several commenters also suggested that the proposed ±.5 dB/1,000 foot limit should be increased to as much as ±1.0 dB/100 meters. After reviewing the proposal in light of the comments and other available technical information, the FAA concludes that the limit should be increased slightly. The provision is also rewritten to clarify that the required comparison is with meteorological measurements obtained at 10 meters above the surface of the noise measuring station. Under the amendment, the limit on atmospheric absorption coefficients is established at ±0.7 dB/1,000 feet in the 3150 Hz one-third octave band.

Another commenter recommended the use of an area-weighted average temperature and relative humidity for the as-measured parameters used in computing the corrections required in proposed § A36.11(d). The FAA considers this method to be an equivalent that could be accepted under § A36.9(d)(3). Accordingly, that comment does not prompt any change from the proposal.

CORRECTION PROCEDURES

The conditions under which noise test are conducted are not always the same and the variations in those conditions affect the comparability of measured data. Accordingly, when the noise certification test conditions do not conform to the prescribed reference conditions, appropriate correction must be made to the EPNL calculated from the measured data. Under the proposed § A36.11, the provisions of current § A36.6 would not be significantly modified.

The proposed rule, as adopted in this amendment, provides an additional procedure which prescribes the corrections for testing at a nonstandard location. For some aircraft which exhibit exceptionally low noise levels during takeoff, the FAA concludes that it may be necessary to bring the takeoff noise measuring station to a point closer to the start of roll to ensure recording the complete flyover noise history. The flyover-noise/time history must include the 10 dB-down points from the maximum tone corrected perceived noise level (PNLTM) both before and after the time of PNLTM, as required under current § B36.5 (proposed § B36.13). The EPNL value computed from these measurements must then be corrected to the value that would have occurred at the prescribed reference takeoff measuring point. The notice proposed separate procedures for making these corrections depending on whether the correction factor exceeds 7.0 dB or results in a final EPNL value which is within 1.5 dB of the prescribed noise level limit. A typographical error in paragraph A36.11(f)(1), regarding the value of the proposed correction limitation (7.0 dB), was noted and is corrected in the amendment.

One commenter suggested that the distinction made in § A36.11(a) between positive and negative correction values should be eliminated. The FAA does not agree. That distinction is prescribed in the current correction procedure and its elimination was not proposed in Notice No. 76-21. In addition, the limitation on the situations in which a negative value (in the difference between reference and test conditions) may be the basis of a correction precludes the interjection of correction factors which may obscure or defeat the purposes of permitting corrections to measured data.

One commenter stated that the integrated procedure (proposed in § A36.11(f)) for normalizing spectra sometimes produces anomalous results because of short term variations that are usually present in actual flight paths. The FAA concludes that the integrated procedure would provide reasonably predictable and verifiable results since the specification includes procedures for normalizing spectra and requires corrections to be made for testing aircraft at a nonstandard location. However, to further avoid anomalous results, the correction limitation on the simple procedure is changed in this amendment to a correction factor value of 8.0 dB and a final EPNL value within 1.0 dB of the prescribed noise limit. The FAA also notes that correction to EPNL to the reference noise measuring point precedes corrections for any differences between test and reference thrust and airspeed. The notice referred to the reference airspeed as "velocity." For clarity and consistency, the reference should be stated as "airspeed." This amendment reflects that change and, except as discussed, the nonstandard takeoff location specification is adopted as proposed.

In proposed § A36.11(b)(2), the takeoff profile parameter changes may be derived from FAA approved manufacturer's data. For consistency and clarity, the requirement of FAA approval as a condition to the use of manufacturer data is added to a related provision in paragraph (a)(3)(i). Also, since for approach tests the reference profile is predetermined by the measuring point distance and 3 degree approach glide slope, the last sentence in paragraph (a)(3)(i) is restated to refer to that description in paragraph (c)(2).

In addition, the proposed description of the process for calculating the duration correction due to differences in the test flight paths from the reference flight paths (proposed

§ A36.11(e)) is rewritten in this amendment without substantive change. As adopted, the clarity of the description is improved and unnecessary repetition of methodology under the separate provisions for takeoff, sideline, and approach has been eliminated.

NOY VALUES

Perceived noisiness is expressed in units of "noys" and is based upon the mathematical formulation given in proposed § B36.13. Table B1 was included in Appendix B to provide a ready reference for those applicants who elect not to calculate noy values from the formula. While the original table contains values down to 1.00 noy, lower values are sometimes required in the calculation of EPNL for low noise aircraft. Thus, the FAA proposed to expand Table B1 to provide those lower values. Such a revised table had been prepared by the Society of Automotive Engineers and published in ARP 865. The International Standards Organization concurred with that revision (ISO/IC 43/SC1, revised March 3, 1975). The ICAO currently has under consideration a similar revision. Table B2 is also amended to conform to the expanded Table B1.

One commenter correctly noted that the constant of 33.3 used in computing PNL(K) (§ B36.3) should be changed in light of the modifications made to the Noy values in deriving Table B1 from the original noy curves. Accordingly, the constant in Step 3 under new § B36.3(c) has been changed from 33.3 to 33.22. As amended, the underlying formula reads: "PNL(K)=40.00+33.22 log N(K)."

PSEUDOTONE ELIMINATION AND SPECTRAL IRREGULARITIES CORRECTION

In the notice, the FAA proposed to add two new paragraphs, (m) and (n), after the last undesignated paragraph of current § B36.3 (proposed § B36.5(1)). The first new paragraph prescribes the exclusion of certain tones (resulting from ground-plane reflection) from calculations of corrections for spectral irregularities. The second paragraph prescribes the evaluation of the five one-half second noise level samples around the initially calculated PNLTM. The FAA stated that it believed that occasionally the prescribed ten-step procedure for calculating corrections for spectral irregularities yields incorrect values since it tends to undercompensate for tones occurring in frequencies near the cross- over point between adjacent one-third octave filters. The FAA, ICAO, SAE and others have considered several methods for overcoming this deficiency. After consideration of the side effects of the other methods, the FAA concluded that the proposed procedure provides the most appropriate and consistent results.

In Notice No. 76-21, the FAA also proposed to amend Table B2 to account for tone level differences less than 3.0 decibels in amplitude, since the current table provides no tone correction for those level difference values. Table B2 was originally constructed to avoid the possibility that small false tones, "pseudotones", would be mistakenly retained during the data processing. These pseudotones result from interference patterns in the sound field near the Earth's surface during an aircraft flyover. However, FAA noise certification experience with the pseudotone problem under current § B36.5 indicates that such precautions are no longer necessary. Since similar action has been taken by the ICAO, the FAA proposed, and in this amendment adopts, the elimination of the 3.0 decibel lower limit on the level difference used to determine the tone correction. The example contained in Table B3 is also amended to reflect the necessary minor changes. Further, a revised and expanded discussion on the methods for identifying and eliminating pseudotones is provided in new paragraphs B36.5(m) and (n) and discussed below. The FAA concludes that these provisions are needed to clarify the prescribed methodology in the noise certification procedure.

One commenter objected to further refinements to the tone correction procedure in proposed § B36.5(m). The commenter stated that in view of its controversial nature, he recommended deletion of the requirement to account for the factors F(i,K), regarding sound pressure level differences between 0 and 3 decibels.

One commenter recommended deletion of the requirement to account for band sharing in the tone correction procedure proposed in § B36.5(n). The commenter recommended that tone corrections should not be applied when the spectral irregularity is caused by the deletion of those one-third octave band sound pressure levels (SPLs) that are within 5 dB of the ambient noise levels. The FAA agrees that the procedure as proposed should not be adopted but does not agree the accountability for band sharing should be deleted altogether. The proposed requirement would have accounted for band sharing in the tone correction procedure and required a judgmental decision on each specific case. Furthermore, the process would have not lent itself to computerized methods of computation since no known procedure consistently obtains a final result for a variety of spectra. Accordingly, the requirement to account for band sharing in the proposed tone correction procedure is modified to eliminate the ad hoc judgment in accounting for band sharing and to substitute an arithmetic analysis using the average value of the five successive time intervals, including two preceding and two succeeding time intervals, in computing a new value for the maximum PNLT.

EFFECT ON NOISE LEVEL LIMITS

Many commenters in response to the notice, and to Notice Nos. 75-37, 75-37C, and 76-22 regarding proposed noise level limit reductions, expressed concern that the proposed change in the procedures and standards for conducting aircraft noise tests proposed in Notice No. 76-21 might effectively increase, or decrease, the stringency of the Part 36 noise level limits. Some commenters objected to the noise test specification proposals because they felt the aircraft noise standards, and particularly the noise limits, would necessarily become more stringent if the proposals were adopted.

The FAA has reviewed the proposals in light of the comments and data presented to the docket, the amended noise level limits and acoustical change requirements for the affected airplanes, and other data and information available to it. The FAA agrees that the stringency of aircraft noise certification requirements for certain portions of the noise measurement and evaluation specifications is increased under this amendment. However, the FAA feels that the increase is reasonable and that most, if not all, of the increase results from the refinements and new methodology reflected by the current state of the art which, when applied, enhances the accuracy, repeatability, and creditability of the aircraft noise test data. The FAA concludes, however, that there is no demonstrated basis for anticipating that the noise level limits prescribed under Appendix C to Part 36 are made significantly more stringent for noise demonstrations than they are under the current Appendices A and B.

The FAA recognizes the interrelation between the test methodology and resulting noise levels. That relationship is a major reason for the proposed amendment. Under this amendment, the latitude permitted under the current specifications is reduced for some procedures and standards and is increased for some others (where adequate precautions, such as corrections and limitations, have been provided). For example, there may be some noise test sites where noise testing is currently conducted under Part 36 that may be limited under the specifications adopted in this amendment. However, some meteorological conditions which currently preclude noise testing under Part 36 will not have that effect under this amendment. Also test conditions are more readily and accurately correctable to the prescribed reference conditions. Under this amendment, the FAA con-

cludes that the unnecessarily broad latitude permitted in the current noise measurement and evaluation specifications is eliminated. Thus, under this amendment, the specifications are clarified and up-dated to reflect the current state of the acoustic arts. The FAA does not agree with commenters who suggested that implementation of specifications proposed in Notice No. 76-21 should be delayed in order to gain further experience with them. The benefits of these specifications regarding improved accuracy, repeatability, and creditability of aircraft noise test data under Part 36, have been discussed in the notice and in this preamble. The FAA concludes that it has sufficient technical basis to support the specifications adopted in this amendment and that the public interest would not be served by postponing achievement of the benefit of this amendment as suggested by some commenters. The FAA notes that in several respects the specifications adopted in this amendment have already been adopted, or are being considered for adoption, by the ICAO.

Incorporation by Reference

Currently, published technical materials that are incorporated by reference in Part 36 under 5 U.S.C. 552(a) and 1 CFR Part 51 are separately prescribed in the substantive provisions of the respective appendices. In Notice No. 76-21, the FAA proposed, and this amendment adopts, a new section under the general provisions in Subpart A which executes the incorporations by reference and consolidates the required statements of identification and availability of the incorporated materials. By so doing, the readability of the affected provisions is improved and the need for repetitive material is kept to a minimum. The new section 36.6 (proposed § 36.9) also serves as a technical bibliography and reference source for information regarding the incorporated materials. Under the amendment, the individual referencing provisions in the specifications identify incorporated material that is part of that provision and cross-reference new § 36.6. This amendment adopts the materials incorporated by reference according to the date of the material specified in the reference as proposed. Notice and public procedure will precede the adoption of any subsequent editions of, or changes to, the incorporated materials.

The Director of the Federal Register approved the incorporations by reference contained in this amendment on July 6, 1977, and a copy of each incorporated publication was filed with the Director and is available in the Federal Register Library and as provided in paragraphs 36.6 (d) and (e).

Conformity With Other Rulemakings

Notice No. 76-21 did not contain any proposals regarding the noise level requirements under Appendix C to Part 36. However, amendments to Appendix C regarding takeoff and approach noise measuring point distances were proposed in Notice No. 75-37C (41 FR 47375; October 28, 1976) and adopted in Amendment 36-8. That amendment necessitated certain conforming amendments in Appendix A. Several commenters noted the relationship between the two proposed rules and urged that they be considered together. The FAA agrees. Since this amendment revises Appendix A, the needed changes in the description of the prescribed noise tests adopted in Amendment 36-8 are reflected in this amendment. The basis and purpose of the amendments to Appendix C (§ C36.3 (a) and (b)) are discussed in the preamble to Amendment 36-8 and apply to the complementary amendments in Appendix A. Accordingly, references to the takeoff and approach noise measuring point distances (3.5 and 1.0 nautical miles, respectively) and to the corresponding aircraft approach height and reference approach flight path altitude (370 and 369 feet, respectively) are amended in the various provisions and tables under Appendix A in which they appear. Under this amendment the takeoff and approach noise measuring point distances are 21,325 feet and 6,562 feet, respectively: the related heights, i.e., aircraft approach height (symbol "NH") and reference approach flight path altitude (symbol "NT"), are 394 feet and 393 feet respectively.

Effective Date

In the notice, the FAA proposed to make the proposed rule applicable to noise certification tests conducted after March 31, 1977, or 30 days after publication of the final amendment, which even occurs later.

In proposing a compliance date, the FAA considered that, if adopted, the new provisions could, in some cases, require additional instrumentation or revisions to existing data processing and analysis computer programs. Although the amendments generally follow already established practices and standards, the FAA was aware that some potential applicants may have had little or no recent noise certification experience comparable to that prescribed under the specifications adopted in this amendment. For those persons, the amendments may impose some new burden. To ensure that a reasonable period for these changes to be made and that the earliest effectivity would be achieved, the FAA indicated its intentions and proposed that compliance with the amended Appendices A and B be required for tests conducted as soon after the effective date of the final amendment as practicable.

In light of the discussion in the notice that it intended to achieve the benefits of the proposed amendments at the earliest reasonable date, the FAA does not agree with those commenters who suggested delaying compliance for at least six months after the amendments are adopted. Further, the FAA concludes that there will be significant advantage in having the same effective/compliance date for the several related amendments to the aircraft noise standards adopted in Amendment 36-8 and this amendment. Under the circumstances, the suggested delayed compliance date is not warranted and could result in significant difficulties regarding compliance with, and administration of, the aircraft noise demonstration tests and noise limits.

Regarding the relationship of this amendment to other rulemakings, the FAA notes that the adoption of this amendment is not anticipated to increase or decrease the noise level measurements of aircraft as compared to those obtained from noise tests conducted under the current Appendices A and B. However, the FAA has issued amendments to the noise limits under Appendix C of Part 36 in Amendments 36-7 and 36-8. The latter amendment also amends the noise measuring point distances and minimum altitudes at which thrust or power may be cut back during takeoff noise tests of certain aircraft. Since the provisions under Appendix C regarding those requirements are reflected in provisions under Appendices A and B affected by this amendment, this amendment also includes those additional changes to Appendices A and B.

The FAA also concludes that to avoid unnecessary complexity due to differing effective dates, this amendment should become effective as part of the comprehensive aircraft noise amendments as soon after October 1, 1977 as possible.

Evaluation of Impacts

Under the regulatory reform policies of the Secretary of Transportation and the Administrator, an evaluation of the anticipated impacts of this amendment has been completed. In addition to the regulatory impacts previously discussed, the evaluation included the cumulative effect of the anticipated impacts.

This amendment primarily concerns test procedure amendments which govern the specifics of conducting and reporting noise certification tests. It neither raises nor lowers the prescribed noise levels and does not require retesting of currently certificated airplanes or additional tests to be performed during the certification

process. As a result, little or no change is anticipated in the noise levels of aircraft type certificated under this amendment and there is no anticipated change in the amount of fuel used to conduct the tests or the amount of engine emissions produced during the tests. Since this amendment requires no additional limitations on in-service operations or performance, no increase in fuel usage or emissions is anticipated to result from aircraft certificated under the amended specifications.

The amendment is more stringent than the current rule in the requirement for noise certification test equipment, in the specification of the weather conditions, and in correction of test data to standard conditions. The increased stringency could, in some cases, increase the applicant's costs of noise type certification. However, the FAA concludes that those costs are not unreasonable and could be offset by savings that would accrue from increased repeatability of the data and from reducing the likelihood that demonstration tests must be rerun. Current industry practice is to design and build aircraft using a tolerance below the actual noise level goals. The requirement for this tolerance arises largely from uncertainties in the repeatability of the data from tests under the current Part 36 procedures. Therefore, by increasing the repeatability of the data, the amended rule contributes to a reduction in costs by eliminating unnecessary design features or performance limitations which would be introduced solely to meet the tolerance requirements. The increased accuracy and reliability of test data also reduce the likelihood that a test would have to be rerun to demonstrate the requisite confidence level in the noise measurements.

The anticipated increased costs and offsetting economic benefits analyzed in the NED demonstrate the economic impacts of this amendment. These impacts have been evaluated in accordance with Executive Order 11821, as amended by Executive Order 11949, and under OMB Circular A-107 and DOT Order 2050.4. From that evaluation, it was determined that this amendment would not significantly increase costs to the private sector, to consumers, or to Federal, State, or local governments. Accordingly, the FAA has concluded that the cumulative impact of this amendment is not inflationary in nature and is not a major proposal for which an economic impact statement is required.

Drafting Information

The principal authors of this document are Richard Tedrick, Office of Environmental Quality, and Ronn E. Harding, Office of the Chief Counsel.

Adoption of the Amendment

Accordingly, Part 36 of the Federal Aviation Regulations (14 CFR Part 36) is amended, effective April 3, 1978, as follows:

1. Subpart A of Part 36 is amended by adding a new § 36.6 to read as follows:

§ 36.6 Incorporations by reference.

(a) *General.* This part prescribes certain standards and procedures which are not set forth in full text in the rule. Those standards and procedures are contained in published material which is reasonably available to the class of persons affected and has been approved for incorporation by reference by the Director of the Federal Register under 5 U.S.C. § 552 (a) and 1 CFR Part 51.

(b) *Incorporated matter.* (1) Each publication, or part of a publication, which is referenced but not set forth in full-text in this part and which is identified in paragraph (c) of this section is hereby incorporated by reference and made a part of Part 36 of this chapter with the approval of the Director of the Federal Register.

(2) Incorporated matter which is subject to subsequent change is incorporated by reference according to the specific reference and to the identification statement. Adoption of any subsequent change in incorporated matter is made under Part 11 of this chapter and 1 CFR Part 51.

(c) *Identification statement.* The complete title or description which identifies each published matter incorporated by reference in this part is as follows:

(1) *International Electrotechnical Commission (IEC) Publications.* (i) IEC Publication No. 179, entitled "Precision Sound Level Meters," dated 1973.

(ii) IEC Publication No. 225, entitled "Octave, Half-Octave, Third Octave Band Filters Intended for the Analysis of Sounds and Vibrations," dated 1966.

(2) *Society of Automotive Engineers (SAE) Publications.* (i) SAE ARP 866A, entitled "Standard Values of Atmospheric Absorption as a Function of Temperature and Humidity for Use in Evaluating Aircraft Flyover Noise," dated March 15, 1975.

(ii) [Reserved]

(d) *Availability for purchase.* Published material incorporated by reference in this part may be purchased at the price established by the publisher or distributor at the following mailing addresses:

(1) *IEC publications.* (i) The Bureau Central de la Commission Electrotechnique Internationale, 1, rue de Varembe, Geneva, Switzerland.

(ii) American National Standard Institute, 1430 Broadway, New York City, New York 10018.

(2) *SAE publications.* Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrentown, Pennsylvania 15096.

(e) *Availability for inspection.* A copy of each publication incorporated by reference in this part is available for public inspection at the following locations:

(1) FAA Office of the Chief Counsel, Rules Docket, Room 916, Federal Aviation Administration Headquarters Building, 800 Independence Avenue, SW., Washington, D.C.

(2) Department of Transportation, Branch Library, Room 930, Federal Aviation Administration Headquarters Building, 800 Independence Avenue, SW., Washington, D.C.

(3) The respective Regional Offices of the Federal Aviation Administration as follows:

(i) New England Regional Office, 12 New England Executive Park, Burlington, Massachusetts.

(ii) Eastern Regional Office, Federal Building, John F. Kennedy (JFK) International Airport, Jamaica, New York.

(iii) Southern Regional Office, 3400 Whipple Street, East Point, Georgia.

(iv) Great Lakes Regional Office, 2300 East Devon, Des Plaines, Illinois.

(v) Central Regional Office, 601 East Twelfth Street, Kansas City, Missouri.

(vi) Southwest Regional Office, 4400 Blue Mound Road, Fort Worth, Texas.

(vii) Rocky Mountain Regional Office, 10255 East 25th Avenue, Aurora, Colorado.

(viii) Northwest Regional Office, FAA Building, 9010 East Marginal Way South, King County International Airport (Boeing Field), Seattle, Washington.

(ix) Western Regional Office, 15000 Aviation Boulevard, Hawthorne, California.

(x) Alaskan Regional Office, 632 Sixth Avenue, Anchorage, Alaska.

(xi) Pacific-Asia Regional Office, 1833 Kolakoua Avenue, Honolulu, Hawaii.

(xii) European Regional Office, Tour Madou Building, 1, Place Madou, 1020 Brussels, Belgium.

(4) The Office of the Federal Register, Room 8401, 1100 "L" Street, NW., Washington, D.C.

Appendix A

2. Appendix A is amended by adding a table of sections and by revising the appendix to read as follows:

Appendix A—Aircraft Noise Measurement Under § 36.101

Sec.

A36.1 *Noise certification test and measurement conditions.*
A36.3 *Measurement of aircraft noise received on the ground.*
A36.5 *Reporting and correcting measured data.*
A36.7 *Symbols and units.*
A36.9 *Atmospheric attenuation of sound.*
A36.11 *Detailed correction procedures.*

A36.1 *Noise certification test and measurement conditions.*

(a) *General.* This section prescribes the conditions under which aircraft noise certification tests must be conducted and the measurement procedures that must be used to measure aircraft noise during each test conducted on or after April 3, 1978.

(b) *Test site requirements.* (1) Tests to show compliance with established aircraft noise certification levels must consist of a series of takeoffs and approaches during which measurements must be taken at noise

measuring stations located at the measuring points prescribed in § C36.3 of Appendix C of this part.

(2) During each test takeoff, simultaneous measurements should be made at the sideline noise measuring stations on each side of the runway and also at the takeoff noise measuring station. However, if test site conditions make it impractical to simultaneously measure takeoff and sideline noise, and if each of the other sideline measurement requirements is met, independent measurements may be made of the sideline noise under simulated flight path techniques. If the reference flight path includes a power cutback before the maximum possible sideline noise level is developed, the reduced sideline noise level which is the maximum value developed by the simulated flight path technique must be the certificated sideline noise value.

(3) If the height of the ground at a noise measuring station differs from that of the nearest point on the runway by more than 20 feet, corrections must be made as prescribed in § A36.5(d) of this appendix.

(4) The location of each noise measuring station must be surrounded by relatively flat terrain having no excessive sound absorption characteristics, such as might be caused by thick, matted, or tall grass, shrubs, or wooded areas.

(5) An airport tower, or other facility, used to obtain required measurements of meteorological conditions at the test site must be approved in accordance with § A36.9(b)(1) of this appendix.

(6) During the period when the flyover noise/time record indicates the noise measurement is within 10 dB of PNLTM, no obstruction that significantly influences the sound field from the aircraft may exist—

(i) For a takeoff, approach, or sideline measuring station, within a conical space above the measuring position (the point on the ground vertically below the microphone), the cone being defined by an axis normal to the ground and by a half-angle 80 degrees from this axis; and

(ii) For a sideline noise measuring station, above the line of sight between the microphone and the aircraft.

(7) A minimum of four sideline noise measuring stations must be used to define the maximum sideline noise with respect to location and level as required by § C36.3 of Appendix C of this part. One of the microphones must be placed symmetrically with respect to one of the other microphones so that the maximum noise on either side of the aircraft can be determined analytically.

(c) *Weather restrictions.* The tests must be conducted under the following atmospheric conditions:

(1) No rain or other precipitation.

(2) Ambient air temperature between 36 degrees F and 95 degrees F (2.2 degrees C and 35 degrees C), inclusively, over that portion of the sound propagation path between the aircraft and a point 10 meters above the ground at the noise measuring station.

(3) Relative humidity and ambient temperature over that portion of the sound propagation path between the aircraft and a point 10 meters above the ground at the noise measuring station is such that the sound attenuation in the one-third octave band centered at 8 kHz is not greater than 12 dB/100 meters and the relative humidity is between 20 percent and 95 percent, inclusively.

(4) Airport reported wind velocity 10 meters above ground does not exceed 10 knots and the crosswind component does not exceed 5 knots.

(5) No anomalous wind conditions (including turbulence) which will significantly affect the noise level of the aircraft when the noise is recorded at each noise measuring station.

(d) *Aircraft testing procedures.*—(1) The aircraft testing procedures and noise measurements must be conducted and processed in an approved manner which yields the noise evaluation measure designated as Effective Perceived Noise Level (EPNL) in units of EPNdB, as prescribed in Appendix B of this part.

(2) The aircraft height and lateral position relative to the extended centerline of the runway must be determined by an FAA approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(3) The aircraft position along the flight path must be related to the noise recorded at the noise measuring stations by means of synchronizing signals at an approved sampling rate. The position of the aircraft must be recorded relative to the runway during the entire time period in which the recorded signal is within 10 dB of PNLTM. Measuring and sampling equipment must be approved by the FAA.

(4) Each takeoff test must meet the conditions of § C36.7 of Appendix C of this part.

(5) If a takeoff test series is conducted at weights other than the maximum takeoff weight for which noise certification is requested, the following additional requirements apply:

(i) At least one takeoff test must be conducted at a weight at, or above, the maximum certification weight.

(ii) Each test weight must be within +5 percent or −10 percent of the maximum certification weight.

(iii) Approved data must be used to determine the variation of EPNL with weight for takeoff test conditions.

(6) Each approach test must be conducted with the aircraft stabilized and following a 3.0 degree ±0.5 degree approach angle and must meet the requirements of § C36.9 of Appendix C of this part.

(7) If an approach test series is conducted at weights other than the maximum landing weight for which certification is requested, the following additional requirements apply:

(i) At least one approach test must be conducted at a weight at, or above, the maximum landing weight.

(ii) Each test weight must exceed 90 percent of the maximum landing weight.

(iii) Approved data must be used to determine the variation of EPNL with weight for approach test conditions.

(8) Aircraft performance data sufficient to make the correction required under § A36.5 of this appendix must be recorded at an approved sampling rate using FAA approved equipment.

§ A36.3 *Measurement of aircraft noise received on the ground.* (a) *General.*—(1) The measurements prescribed in this section provide the data for determining the one-third octave band noise produced by aircraft during testing at specific noise measuring stations, as a function of time.

(2) Sound pressure level data for aircraft noise certification purposes must be obtained with approved acoustical equipment and measurement practices.

(3) Paragraphs (b), (c), and (d) of this section prescribe the required equipment specifications. Paragraphs (e) and (f) prescribe the calibration and measurement procedures required for each certification test series.

(b) *Measurement system.*—The acoustical measurement system must consist of approved equipment equivalent to the following:

(1) A microphone system with frequency response and directivity which are compatible with the measurement and analysis system accuracy prescribed in paragraph (c) of this section.

(2) Tripods or similar microphone mountings that minimize interference with the sound energy being measured.

(3) Recording and reproducing equipment whose characteristics, frequency response, and dynamic range are compatible with the response and accuracy requirements of paragraph (c) of this section.

(4) Calibrators using sine wave, or pink noise, of known levels. When pink noise (defined in paragraph (e)(1) of this section) is used, the signal must be described in terms of its root-mean-square (rms) value.

(5) Analysis equipment with the response and accuracy which meets or exceeds the requirements of paragraph (d) of this section.

(6) Attenuators used for range changing in sensing, recording, reproducing, or analyzing aircraft sound must be capable of being operated in equal-interval decibel steps with no error between any two settings which exceeds 0.2 dB.

(c) *Sensing, recording, and reproducing equipment.* (1) The sound produced by the aircraft must be recorded in such a way that the complete information, including time history, is retained. A magnetic tape recorder is acceptable.

(2) The microphone must be a pressure-sensitive capacitive type, or its approved equivalent, such as a free-field type with incidence corrector.

(i) The variation of microphone and preamplifier system sensitivity within an angle of ±20 degree of grazing (70–110 degrees from the normal to the diaphragm) must not exceed ±2.0 dB for any frequency within the range of 44 Hz to 11,200 Hz. The variation of microphone sensitivity in the plane of the diaphragm must not exceed ±0.5 dB over the same frequency range.

(ii) The overall free-field frequency response at 90 degrees (grazing incidence) of the combined microphone (including incidence corrector, if applicable) preamplifier, and windscreen must be determined by using (A) an electrostatic calibrator in combination with manufacturer-provided corrections, or (B) an anechoic free-field facility. The calibration unit must include pure tones at each preferred one-third octave frequency from 50 Hz to 10,000 Hz. The frequency response (after corrections based on that determination) must be flat within the following tolerances:

44-3549 Hz	±0.25 dB
3550-7099 Hz	±0.5 dB
7,100-11,200 Hz	±1.0 dB

(iii) Specifications concerning sensitivity to environmental factors such as temperature, relative humidity, and vibration must be in conformity with the recommendations of International Electrotechnical Commission (IEC) Publication No. 179, entitled "Precision Sound Level Meters" (as incorporated by reference under § 36.6 of this part).

(iv) If the wind speed exceeds 6 knots, a windscreen must be employed with the mi-

crophone during each measurement of aircraft noise. Correction for any insertion loss produced by the windscreen as a function of frequency, must be applied to the measured data and any correction applied must be reported.

(3) If a magnetic tape recorder is used to store data for subsequent analysis, the record/replay system (including tape) must conform to the following:

(i) The electric background noise produced by the system in each one-third octave must be at least 35 dB below the standard recording level, which is defined as that level which is either 10 dB below the 3 percent harmonic distortion level for direct recording or ±40 percent deviation for frequency modulation (FM) recording.

(ii) At the standard recording level, the corrected frequency response in each selected one-third octave band between 44 Hz and 180 Hz must be flat within ±0.75 dB, and in each band between 180 Hz and 11,200 Hz must be flat within ±0.25 dB.

(iii) If the overall system satisfies the requirements of paragraph (c)(2)(ii) of this section, and if the limitations of the dynamic range of the equipment are insufficient to obtain adequate spectral information, high frequency pre-emphasis may be added to the recording channel with the converse deemphasis on playback. If pre-emphasis is added, the instantaneously recorded sound-pressure level between 800 Hz and 11,200 Hz of the maximum measured noise signal must not vary more than 20 dB between the levels of the maximum and minimum one-third octave bands.

(d) *Analysis equipment.*—(1) A frequency analysis of the acoustic signal must be performed using one-third octave filters which conform to the recommendations of International Electrotechnical Commission (IEC) Publication No. 225, entitled "Octave, Half-Octave, and Third-Octave Band Filters Intended for Analysis of Sounds and Vibrations" (as incorporated by reference under § 36.6 of this part).

(2) A set of 24 consecutive one-third octave filters must be used. The first filter of the set must be centered at a geometric mean frequency of 50 Hz and the last filter at 10,000 Hz. The output of each filter must contain less than 0.5 dB ripple.

(3) The analyzer indicating device may be either analog or digital, or a combination of both. The preferred sequence of signal processing is:

(i) Squaring the one-third octave filter outputs;

(ii) Averaging or intergrating; and

(iii) Coverting linear formulation to logarithmic.

(4) Each detector must operate over a minimum dynamic range of 60 dB and perform as a true-mean-square device for sinusoidal tone bursts having crest factors of at least 3 over the following dynamic range:

(i) Up to 30 dB below full-scale reading must be accurate within ±0.5 dB;

(ii) Between 30 dB and 40 dB below full-scale reading must be accurate within ±1.0 dB; and

(iii) In excess of 40 dB below full-scale reading must be accurate within ±2.5 dB.

(5) The dynamic response of the analyzer to input signals in both full-scale, and 20 dB less than full-scale, amplitude must conform to the following requirements:

(i) When a sinusoidal pulse of 500 millisecond duration at the geometrical mean frequency of each one-third octave band is applied to the input, the maximum output value must read 4.0 dB (within +0.5 or −1.0 dB) less than the value obtained for a steady state sinusoidal signal of the same frequency and amplitude.

(ii) When a steady state sinusoidal signal at the geometrical mean frequency of each one-third octave band is suddenly applied to the analyzer input and held constant, the maximum output value must exceed the final steady state value by 0.5±0.5 dB.

(iii) When a steady state signal is interrupted, an output value of 2.5±1.0 dB below the initial steady-state response must be achieved within 500 milliseconds after the interruption.

(6) A single value of the root-mean-square (rms) level must be provided every 500±5 milliseconds for each of the 24 one-third octave bands. The levels for all of the 24 one-third octave bands must be obtained within a 50 millisecond period. No more than 5 milliseconds of data from any 500 millisecond period may be excluded from the measurement.

(7) The amplitude resolution of the analyzer must be a least 0.25 dB.

(8) After all systematic errors have been eliminated, each output level from the analyzer must be accurate within ±1.0 dB of the level of the input signal. The total systematic errors for each of the output levels must not exceed ±3.0 dB. For contiguous filter systems, the systematic correction between adjacent one-third octave channels must not exceed 4.0 dB.

(9) The dynamic range capability of the analyzer for display of a single aircraft noise event (in terms of the difference between full-scale output level and the maximum noise level of the analyzer equipment) must be at least 60 dB.

(e) *Calibrations.*—(1) Within the five days before the beginning of each test series, the complete electronic system (as installed in the field, including cables) must be electronically calibrated for frequency and amplitude by the use of a pink noise signal of known amplitudes covering the range of signal levels furnished by the microphone. For purposes of this section, a "pink noise" means a noise whose noise-power/unit-frequency is inversely proportional to frequency at frequencies within the range of 44 Hz to 11,200 Hz. The signal used must be described in terms of its average root-mean-square (rms) values for a nonoverload signal level. This system calibration must be repeated within five days of the end of each test series, or as required by the FAA.

(2) Immediately before and after each day's testing, a recorded acoustic calibration of the system must be made in the field with an acoustic calibrator to check the system sensitivity and provide an acoustic reference level for the analysis of the sound level data. The performance of equipment in the system will be considered satisfactory if, during each day's testing, the variation does not exceed 0.5 dB.

(3) A normal incidence pressure calibration of the combined microphone/preamplifier must be performed with pure tones at each preferred one-third octave frequency from 50 Hz to 10,000 Hz. This calibration must be completed within the 90 days before the beginning of each test series.

(4) Each reel of magnetic tape must:

(i) Be pistonphone calibrated; and

(ii) At its beginning and end, carry a calibration signal consisting of at least a 15 second burst of pink noise, as defined in paragraph (e)(1) of this section.

(5) Data obtained from tape recorded signals are not considered reliable if the difference between the pink noise signal levels, before and after the tests in each one-third octave band, exceeds 0.75 dB.

(6) The one-third octave filters must have been demonstrated to be in conformity with the recommendations of IEC Publication 225 (as incorporated by reference under § 36.6 of this part) during the six calendar months preceding the beginning of each test series. However, the correction for effective bandwidth relative to the center frequency response may be determined for each filter—

(i) By measuring the filter response to sinusoidal signals at a minimum of twenty frequencies equally spaced between the two adjacent preferred one-third octave frequencies; or

(ii) By using an approved alternative technique.

(7) A performance calibration analysis of each piece of calibration equipment, including pistonphones, reference microphones, and voltage insert devices, must have been made during the 12 calendar months preceding the beginning of each day's test series. Each calibration must be traceable to the National Bureau of Standards.

(f) *Noise measurement procedures.* (1) Each microphone must be oriented so that the diaphragm is substantially in the plane defined by the flight path of the aircraft and the measuring station. The microphone located at each noise measuring station must be placed so that its sensing element is approximately 4 feet above ground.

(2) Immediately before and immediately after each series of test runs and each day's testing, a recorded acoustic calibration of the system prescribed in A36.3(e)(2) of this appendix must be made in the field to check the acoustic reference level for the analysis of the sound level data. Ambient noise must be recorded for at least 10 seconds and be representative of the acoustical background, including systemic noise, that exists during the flyover test run. During that recorded period, each component of the system must be set at the gain-levels used for aircraft noise measurement.

(3) The mean background noise spectrum must contain the sound pressure levels, which, in each preferred third octave band in the range of 50 Hz to 10,000 Hz, are the averages of the energy of the sound pressure levels in every preferred third octave. When analyzed in PNL, the resulting mean background noise level must be at least 20 PNdB below the maximum PNL of the aircraft.

(4) Corrections for recorded levels of background noise are allowed, within the limits prescribed in § A36.5(d)(3) of this appendix.

A36.5. *Reporting and correcting measured data.*

(a) *General.* Data representing physical measurements, or corrections to measured data, including corrections to measurements for equipment response deviations, must be recorded in permanent form and appended to the record. Each correction must be reported and is subject to FAA approval. An estimate must be made of each individual error inherent in each of the operations employed in obtaining the final data.

(b) *Data reporting.* (1) Measured and corrected sound pressure levels must be presented in one-third octave band levels obtained with equipment conforming to the standards prescribed in § A36.3 of this appendix.

(2) The type of equipment used for measurement and analysis of all acoustics, air-

craft performance, and meteorological data must be reported.

(3) The atmospheric environmental data required to demonstrate compliance with § A36.1(c) of this appendix, measured throughout the test period under § A36.9(b)(3) of this appendix, must be reported.

(4) Conditions of local topography, ground cover, or events which may interfere with sound recording must be reported.

(5) The following aircraft information must be reported:

(i) Type, model, and serial numbers (if any) of aircraft engines.

(ii) Gross dimensions of aircraft and location of engines.

(iii) Aircraft gross weight for each test run.

(iv) Aircraft configuration, including flap and landing gear positions.

(v) Airspeed in knots.

(vi) Engine performance in pounds of net thrust, engine pressure ratios, exhaust temperatures, and fan or compressor shaft rotational speeds, as determined from aircraft instruments and manufacturer's data.

(vii) Aircraft flight path (above ground level in feet) determined by an FAA approved method which is independent of normal flight instrumentation, such as radar tracking, theodolite triangulation, laser trajectography, or photographic scaling techniques.

(6) Aircraft speed and position, and engine performance parameters must be recorded at an approved sampling rate sufficient to correct to the noise certification reference conditions prescribed in paragraph (c) of this section. Lateral position relative to the extended centerline of the runway, configuration, and gross weight must be reported.

(c) *Noise certification reference conditions*—(1) *Meteorological conditions.* Aircraft position and performance data and the noise measurements must be corrected to the following noise certification reference atmospheric conditions:

(i) Sea level pressure of 2116 psf (76 cm mercury).

(ii) Ambient temperature of 77 degrees F (25 degrees C).

(iii) Relative humidity of 70 percent.

(iv) Zero wind.

(2) *Aircraft conditions.* The reference condition for takeoff is the maximum weight, except as provided in § 36.1581(b) of this part. The reference conditions for approach tests consist of—

(i) Design landing weight, except as provided in § 36.1581(b) of this part;

(ii) Approach angle of 3 degrees; and

(iii) Aircraft height of 394 feet above the ground at the noise measuring station.

(d) *Data corrections.* (1) Aircraft position and performance data and the noise measurement must be corrected to the noise certification reference conditions as prescribed in paragraph (c) of this section. The measured atmospheric conditions must be those obtained in accordance with § A36.1(c) of this appendix and paragraph (b)(3) of sound corrections must be made under § A36.9 of this appendix.

(2) The measured flight path must be corrected by an amount equal to the difference between the applicants predicted flight path for the certification reference conditions and the measured flight path at the test conditions. Necessary corrections relating to aircraft flight path or performance may be derived from approved data other than certification test data. The source noise must be corrected from approved data for the difference between measured and reference engine conditions, together with appropriate allowances for sound attenuation with distance. The Effective Perceived Noise Level (EPNL) correction must be less than 2.0 EPNdB for any combination of the following:

(i) The aircraft's not passing vertically above the measuring station.

(ii) Any difference between 394 feet and the actual minimum distance of the aircraft's ILS antenna from the approach measuring station.

(iii) Any difference between the actual approach angle and the noise certification reference approach flight path.

(iv) Any correction of the measured noise levels which accounts for any difference between the test engine thrust or power and the reference engine thrust or power.

Detailed correction requirements are prescribed in § A36.11 of this appendix.

(3) Aircraft sound pressure levels within the 10 dB-down points (described in § B36.9 of Appendix B) must exceed the mean background sound pressure levels determined under § A36.3(f)(3) by at least 5 dB in each one-third octave band (or be corrected under an FAA approved method) to be included in the computation of the overall noise level of the aircraft. An EPNL may not be computed or reported from data from which more than four one-third octave bands in any spectrum within the 10 dB-down points have been excluded under this paragraph.

(e) *Validity of results.* (1) The test results must produce three average EPNL values within the 90 percent confidence limits, each value consisting of the arithmetic average of the corrected noise measurements for all valid test runs at the takeoff, approach, and sideline measuring stations, respectively. If more than one noise measurement system is used at any single measuring station, the resulting data for each test run (after correction) must be averaged as a single measurement. If more than one test site or noise measuring station location is used, each valid test run must be included in the computation of the average EPNL values and their confidence limits.

(2) The minimum sample size acceptable for each of the three certification measurements (takeoff, approaches, and sideline) is six. The number of samples must be large enough to establish statistically for each of the three average noise certification levels a 90 percent confidence limit which does not exceed ±1.5 EPNdB. No test result may be omitted from the averaging process, unless otherwise specified by the FAA.

(3) The average EPNL values and their 90 percent confidence limits obtained by the procedure described in this paragraph must be those by which the noise emission of the aircraft is assessed against the noise certification criteria, and must be reported.

§ A36.7 *Symbols and units.*

(a) *General.* The symbols used in Appendixes A and B of this Part have the following meanings.

Symbol	Unit	Meaning
ant	—	*Antilogarithm to the Base 10.*
C(k)	dB	*Tone Correction.* The factor to be added to PLN(k) to account for the presence of spectral irregularities such as tones at the k-th increment of time.
d	sec	*Duration Time.* The length of the significant noise time history being the time interval between the limits of t(1) and t(2) to the nearest second.
D	dB	*Duration Correction.* The factor to be added to PNLM to account for the duration of the noise.
EPNL	EPNdB	*Effective Perceived Noise Level.* The value of PNL adjusted for both the presence or discrete frequencies and the time history. (The unit EPNdB is used instead of the unit dB.)
f(i) or fi	Hz	*Frequency.* The geometrical mean frequency for the i-th one-third octave band.
F(i,k)	dB	*Delta-dB.* The difference between the original and background sound pressure levels in the i-th one-third octave band at the k-th interval of time.
h	dB	*dB-Down.* The level to be subtracted from PNLTM that defines the duration of the noise.
H	%	*Relative Humidity.* The ambient atmospheric relative humidity.
(i) or i	—	*Frequency Band Index.* The numerical indicator that denotes any one of the 24 one-third octave bands with geometrical mean frequencies from 50 to 10,000 Hz.
(k)	—	*Time Increment Index.* The numerical indicator that denotes the number of equal time increments that have elapsed from a reference zero.
log	—	*Logarithm to the Base 10.*
log n (a)	—	*Noy discontinuity Coordinate.* The log n value of the intersection point of the straight lines representing the variation of SPL with log n.
M(b), M(c)	—	*Noy Inverse Slope.* The reciprocals of the slopes of the straight lines representing the variation of SPL with log n.
n	noy	*Perceived Noisiness.* The perceived noisiness at any instant of time that occurs in a specified frequency range.
n(i, k)	noy	*Perceived Noisiness.* The perceived noisiness at the k-th instant of time that occurs in the i-th one-third octave band.

Symbol	Unit	Meaning
n(k)	noy	*Maximum Perceived Noisiness.* The maximum value of all of the 24 values of n(i) that occurs at the k-th instant of time.
N(k)	noy	*Total Perceived Noisiness.* The total perceived noisiness at the k-th instant of time calculated from the 24-instantaneous values of n(i, k).
p(b), p(c)	—	*Noy Slope.* The slopes of the straight lines representing the variation of SPL with log n.
PNL	PNdB	*Perceived Noise Level.* The perceived noise level at any instant of time (the unit PNdB is used instead of the unit dB).
PNL(k)	PNdB	*Perceived Noise Level.* The perceived noise level calculated from the 24 values of SPL (i, k) at the k-th increment of time. (The unit PNdB is used instead of the unit dB.)
PNLM	PNdB	*Maximum Perceived Noise Level.* The maximum value of PNL(k) that occurs during the aircraft flyover. (The unit PNdB is used instead of the unit dB.)
PNLT	PNdB	*Tone Corrected Perceived Noise Level.* The value of PNL adjusted for the presence of spectral irregularities (discrete frequencies) at any instant of time. (The unit PNdB is used instead of the unit dB.)
PNLT(k)	PNdB	*Tone Corrected Perceived Noise Level.* The value of PNL(k) adjusted for the presence of discrete frequencies that occurs at the k-th increment of time. (The unit PNdB is used instead of the unit dB.)
PNLTM	PNdB	*Maximum tone Corrected Perceived Noise Level.* The maximum value of PNLT(k) that occurs during the aircraft flyover. (The unit PNdB is used instead of the unit dB.)
s(i, k)	dB	*Slope of Sound Pressure Level.* The change in level between adjacent one-third octave band sound pressure levels at the i-th band for the k-th instant of time.
Δs(i, k)	dB	*Change in Slope of Sound Pressure Level.*
s'(i, k)	dB	*Adjusted Slope of Sound Pressure Level.* The change in level between adjacent adjusted one-third octave band sound pressure levels at the i-th band for the k-th instant of time.
s(i, k)	dB	*Average Slope of Sound Pressure Level.*
SPL	dB re 0.002 microbar.	*Sound Pressure Level.* The sound pressure level at any instant of time that occurs in a specified frequency range.
SPL(a)	dB re 0.002 microbar.	*Noy Discontinuity Coordinate.* The SPL value of the intersection point of the straight lines representing the variation of SPL with log n.
SPL(b) SPL(c)	dB re 0.002 microbar.	*Noy Intercept.* The intercepts on the SPL-axis of the straight lines representing the variation of SPL with log n.
SPL(i, k)	dB re 0.002 microbar.	*Sound Pressure Level.* The sound pressure level at the k-th instant of time that occurs in the i-th one-third octave band.
SPL'(i, k)	dB re 0.002 microbar.	*Adjusted Sound Pressure Level.* The first approximation to background level in the i-th one-third octave band for the k-th instant of time.
SPL''(i, k)	dB re 0.002 microbar.	*Background Sound Pressure Level.* The final approximation to background level in the i-th one-third octave band for the k-th instant of time.
SPLi	dB re 0.002 microbar.	*Maximum Sound Pressure Level.* The sound pressure level that occurs in the i-th one-third octave band of the spectrum for PNL-TM.
SPLic	dB re 0.002 microbar.	*Corrected Maximum Sound Pressure Level.* The sound pressure level that occurs in the i-th one-third octave band of the spectrum for PNLTM corrected for atmospheric sound absorption.
t	Sec	*Elapsed Time.* The length of time measured from a reference zero.
t(1), t(2)	Sec	*Time Limit.* The beginning and end of the significant noise time history defined by h.
Δt	Sec	*Time Increment.* The equal increments of time for which PNL(k) and PNLT (k) are calculated.
T	Sec	*Normalizing Time Constant.* The length of time used as a reference in the integration method for computing duration corrections.
T	°F	*Temperature.* The ambient atmospheric temperature
αi αi'	dB/ft dB/1000 ft.	*Test Atmospheric Absorption.* The atmospheric attenuation of sound that occurs in the i-th one-third octave band for the measured atmospheric temperature and relative humidity.
αio αio'	dB/ft dB/1000 ft.	*Reference Atmospheric Absorption.* The atmospheric attenuation of sound that occurs in the i-th one-third octave band for the reference atmospheric temperature and relative humidity.
β	degrees	*First Constant Climb Angle.*
γ	degrees	*Second Constant Climb Angle.*
δ	degrees	*Thrust Cutback Angles.*
ϵ	degrees	The angles defining the points on the takeoff flight path at which thrust reduction is started and ended respectively.
η	degrees	*Approach Angle.*
θ	degrees	*Takeoff Noise Angle.* The angle between the flight path and noise path for takeoff operation. It is identical for both measured and corrected flight paths.
λ	degrees	*Approach Noise Angle.* The angle between the flight path and the noise path for approach operation. It is identical for both measured and corrected flight paths.
Δ1	EPNdB	*PNLT Correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences in atmospheric absorption and noise path length between reference and test conditions.
Δ2	EPNdB	*Noise Path Duration Correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to the noise duration because of differences in flyover altitude between reference and test condition.
Δ3	EPNdB	*Weight Correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences between maximum and test aircraft weights.
Δ4	EPNdB	*Approach Angle Correction.* The correction to be added to the EPNL calculated from measured data to account for noise level changes due to differences between 3° and the test approach angle.
ΔAB	feet	*Takeoff Profile Changes.* The changes in the basic parameters defining the takeoff profile due to differences between reference and test conditions.
$\Delta\beta$	degrees	
$\Delta\gamma$	degrees	
$\Delta\delta$	degrees	
Δ	degrees	

FLIGHT PROFILE IDENTIFICATION POSITIONS

Position	Description
A	Start of takeoff roll.
B	Liftoff.
C	Start of first constant climb.
D	Start of thrust reduction.
E	Start of second constant climb.
Ec	Start of second constant climb on corrected flight path.
F	End of noise certification takeoff flight path.
Fc	End of second constant climb on corrected flight path.
G	Start of noise certification approach flight path.
Gr	Start of noise certification approach on reference flight path.
H	Position on approach path directly above noise measuring station.
I	Start of level off.
Ir	Start of level off on reference approach flight path.
J	Touchdown.
K	Takeoff noise measuring station.
L	Sideline noise measuring station (not on flight track).
M	End of noise type certification takeoff flight track.
N	Approach noise measuring station.
O	Threshold of approach end of runway.
P	Start of noise type certification approach flight track.
Q	Position on measured takeoff flight path corresponding to PNLTM at station K.
Qc	Position on corrected takeoff flight path corresponding to PNLTM at station K.
R	Position on measured takeoff flight path nearest to station K.
Rc	Position on corrected takeoff flight path nearest to station K.
S	Position on measured approach flight path corresponding to PNLTM at station N.
Sr	Position on reference approach flight path corresponding to PNLTM at station N.
T	Position on measured approach flight path nearest to station N.
Tr	Position on reference approach flight path nearest to station N.
X	Position on measured takeoff flight path corresponding to PNLTM at station L.
Xc	Position on corrected takeoff flight path corresponding to PNLTM at station L.

FLIGHT PROFILE DISTANCES

Distance	Unit	Meaning
AB	feet	*Length of Takeoff Roll.* The distance along the runway between the start of takeoff roll and lift off.
AK	feet	*Takeoff Measurement Distance.* The distance from the start of roll to the takeoff noise measurement station along the extended centerline of the runway.
AM	feet	*Takeoff Flight Track Distance.* The distance from the start of roll to the takeoff flight track position along the extended centerline of the runway for which the position of the aircraft need no longer be recorded.
KQ	feet	*Measured Takeoff Noise Path.* The distance from station K to the measured aircraft position Q.
KQc	feet	*Corrected Takeoff Noise Path.* The distance from station K to the corrected aircraft position Qc.
KR	feet	*Measured Takeoff Minimum Distance.* The distance from station K to point R on the measured flight path.
KRc	feet	*Corrected Takeoff Minimum Distance.* The distance from station K to point Rc on the corrected flight path.
LX	feet	*Measured Sideline Noise Path.* The distance from station L to the measured aircraft position X.
LXc	feet	*Corrected Sideline Noise Path.* The distance from station L to the corrected aircraft position Xc.
NH	feet	*Aircraft Approach Height.* The vertical distance between the aircraft and the approach measuring station.
NS	feet	*Measured Approach Noise Path.* The distance from station N to the measured aircraft position S.
NSr	feet	*Reference Approach Noise Path.* The distance from station N to the reference aircraft position Sr.
NT	feet	*Measured Approach Minimum Distance.* The distance from station N to point T on the measured flight path.
NTr	feet	*Reference Approach Minimum Distance.* The distance from station N to point Tr on the corrected flight path; it equals 393 feet.
ON	feet	*Approach Measurement Distance.* The distance from the runway threshold to the approach measurement station along the extended centerline of the runway.
OP	feet	*Approach Flight Track Distance.* The distance from the runway threshold to the approach flight track position along the extended centerline of the runway for which the position of the aircraft need no longer be recorded.

§ A36.9 *Atmospheric attenuation of sound.*

(a) *General.* The measured values of the one-third octave band spectra must conform, or be corrected, to the reference-day conditions listed in § A36.5(c) of this appendix. Each correction must account for any differences in the atmospheric attenuation of sound between the test-day conditions and the reference-day conditions along the sound propagation path between the aircraft and the microphone. Unless the meteorological conditions conform to those prescribed in § A36.1(c) of this appendix, the test data are not acceptable.

(b) *Meteorological measurements.* (1) The location of an airport, or other facility, used for meteorological measurements must be approved for use as representative of those atmospheric conditions existing near the surface over the geographical area in which aircraft noise measurements are made. However, for the purpose of making corrections under this section, the wind velocity, temperature, and relative humidity must be measured in the vicinity of the microphones at the takeoff, approach, and sideline measuring stations.

(2) The temperature and relative humidity must be measured from a point 10 meters above the surface at the measuring stations to the altitude of the aircraft, using previously approved equipment and methods.

(3) Meteorological measurements must be obtained within 25 minutes of each noise test measurement. Meteorological data must be interpolated to actual times of each noise measurement.

(c) *Attenuation rates.* The atmospheric attenuation rates of sound with distance for each one-third octave band from 50Hz to 10,000 Hz must be determined in accordance with the formulations and tabulations of SAE ARP 866A, entitled "Standard Values of Atmospheric Absorption as a Function of Temperatures and Humidity for Use in Evaluating Aircraft Flyover Noise" (as incorporated by reference under § 36.6 of this part).

(d) *Correction for atmospheric attenuation.* (1) EPNL values calculated for measured data must be corrected by the methods prescribed in § A36.11(d) of this appendix whenever—

(i) The ambient atmospheric conditions of temperature and relative humidity do not conform to the reference conditions (77 degrees F and 70 percent, respectively), or

(ii) The measured takeoff and approach flight paths do not conform to the reference flight paths.

(2) If the atmospheric absorption coefficients do not vary over the sound propagation path by more than ±0.7 dB/1000 feet in the 3150 Hz one-third octave band from the value of the absorption coefficients derived from the meteorological measurement obtained at 10 meters above the surface of the noise measuring station, the measurements prescribed in paragraph (b)(2) of this section may be used to determine the atmospheric attenuation rates for each one-third octave band.

The resulting atmospheric attenuation rate may be used to compute the PNLT correction under § A36.11(d) of this appendix.

(3) If the conditions do not conform to those prescribed in paragraph (d)(2) of this section, the corrections for atmospheric attenuation must be determined by the following layered-atmosphere procedure:

(i) The sound propagation path must be divided into increments no greater than 100 feet in altitude, and the average temperature and relative humidity that exists within each increment at the time of the test must be calculated from the meteorological data required under paragraph (b) of this section.

(ii) Atmospheric attenuation rates must be determined under paragraph (c) of this section for each one-third octave band in each altitude increment.

(iii) The mean attenuation rate over the complete sound propagation path from the

aircraft to the microphone must be computed for each one-third octave band from 50 Hz to 10,000 Hz. These rates must be used in computing the corrections required in § A36.11(d) of this appendix.

§ A36.11 *Detailed correction procedures.*

(a) *General.* If the test conditions do not conform to those prescribed as noise certification reference conditions under § A36.5 of this appendix, the following correction procedure and requirements apply:

(1) If a positive value results from any difference between reference and test conditions, and appropriate positive correction must be made to the EPNL calculated from the measured data. Conditions which can result in a positive value include:

(i) Atmospheric absorption of sound under test conditions which is greater than the reference;

(ii) Test flight path at an altitude which is higher than the reference; or

(iii) Test weight which is less than maximum certification weight.

(2) If a negative value results from any difference between reference and test conditions, no correction may be made to the EPNL calculated from the measured data, unless the difference results from:

(i) An atmospheric absorption of sound under test conditions which is less than the reference; or

(ii) A test flight path at an altitude which is lower than the reference.

(3) The following correction procedures may produce one or more possible correction values which must be added algebraically to the EPNL calculated as if the tests were conducted completely under the noise certification reference conditions:

(i) The flight profiles must be determined for both takeoff and approach, and for both reference and test conditions. The procedures require noise and flight path recording with a synchronized time signal from which the test profile can be delineated, including the aircraft position for which PNLTM is observed at the noise measuring station. For takeoff, the flight profile corrected to reference conditions may be derived from FAA approved manufacturer's data; however, for approach, the reference profile is prescribed under paragraph (c)(2) of this section.

(ii) The sound propagation paths to the microphone from the aircraft position corresponding to PNLTM are determined for both the test and reference profiles. The SPL values in the spectrum of PNLTM must then be corrected for the effects of—

(A) Change in atmospheric sound absorption;

(B) Atmospheric sound absorption on the change in sound propagation path length; and

(C) Inverse square law on the change in sound propagation path length. the corrected values of SPL are then converted to PNLT from which must be subtracted PNLTM. The resulting difference represents the correction which must be added algebraically to the EPNL calculated from the measured data.

(iii) The minimum distances from both the test and reference profiles to the noise measuring station must be calculated and used to determine a noise duration correction due to any change in the altitude of aircraft flyover. The duration correction must be added algebraically to the EPNL calculated from the measured data.

(iv) From approved data in the form of curves or tables giving the variation of EPNL with engine thrust or test speed, corrections are determined and must be added to the EPNL (which is calculated from the measured data) to account for noise level changes due to differences between test conditions and reference conditions.

(v) From approved data in the form of curves or tables giving the variation of EPNL with approach angle, corrections are determined and must be added algebraically to the EPNL (which is calculated from measured data) to account for noise level changes due to differences between 3 degrees and the test approach angle.

(b) *Takeoff profiles.* (1) Figure A1 illustrates a typical takeoff profile.

(i) The aircraft begins the takeoff roll at point A, lifts off at point B, and initiates the first constant climb at point C at an angle β. The noise abatement thrust cutback is started at point D and completed at point E where the second constant climb is defined by the angle γ (usually expressed in terms of the gradient in percent). The end of the noise certification takeoff flight path is represented by aircraft position F whose vertical projection on the flight track (extended centerline of the runway) is point M. The position of the aircraft must be recorded for the entire interval during which the measured aircraft noise level is within 10 dB of PNLTM. Position K is the takeoff noise measuring station whose distance AK is specified as 21,325 feet (6,500 meters). However, if it is necessary to reduce AK to less than 21,325 feet, the procedures prescribed in paragraph (f) of this section must be followed. Position L is the sideline noise measuring station located on a line parallel to, and the prescribed distance from, the runway centerline where the noise level during takeoff is greatest.

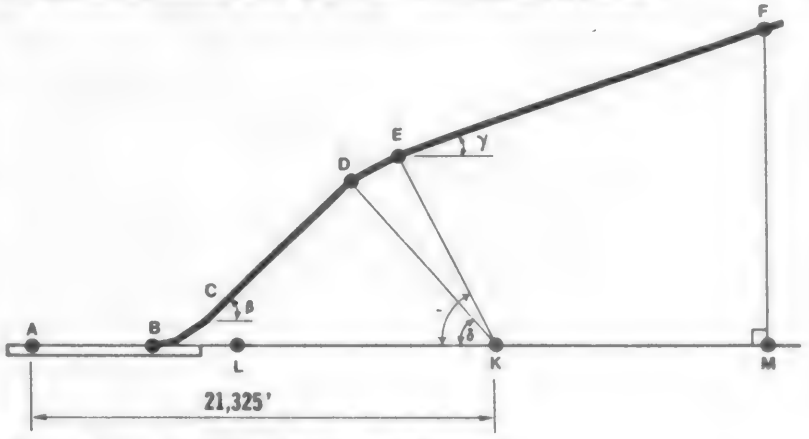


Figure A1. MEASURED TAKEOFF PROFILE

(ii) The take off profile is defined by five parameters—(A) AB, the length of takeoff roll; (B) β, the first constant climb angle; (C) γ, the second constant climb angle; and (D) δ, and ϵ, the thrust cutback angles. These five parameters are functions of the aircraft performance and weight, and the atmospheric conditions of temperature, pressure, and wind velocity and direction.

(2) If the test conditions do not conform to those prescribed as reference conditions under § A36.5 of this appendix, the corresponding test and reference profile parameters will be different, as shown in Figure A2. The profile parameter changes, identifies as ΔAB, $\Delta\beta$, $\Delta\gamma$, $\Delta\delta$, and $\Delta\epsilon$ may be derived from the manufacturer's data (if approved by the FAA) and may be used to define the fight profile corrected to the reference conditions. The relationships between the measured and corrected takeoff flight profiles may then be used to determine the corrections, which, if positive, must be applied to the EPNL calculated from the measured data.

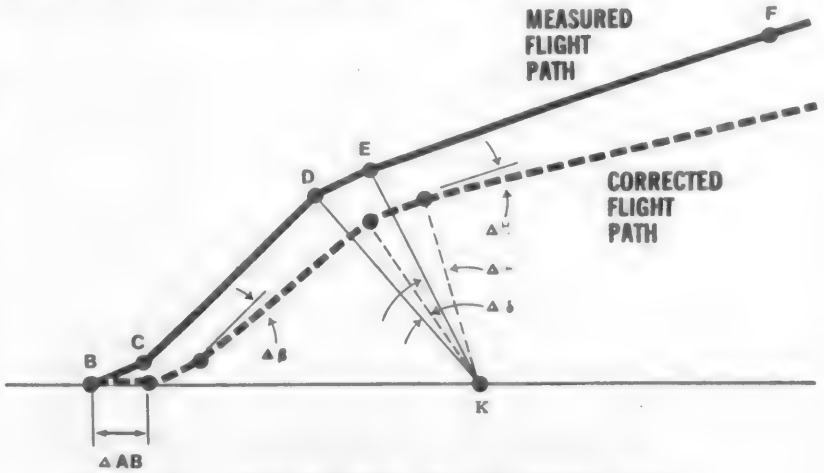


Figure A2. COMPARISON OF MEASURED AND CORRECTED TAKEOFF PROFILES

NOTE.—Under reference atmospheric conditions and with maximum takeoff weight, the gradient of the second constant climb angle (γ) may not be less than 4 percent. However, the actual gradient will depend upon the test atmospheric conditions, assuming maximum takeoff weight and the parameters characterizing engine performance are constant (rpm, epr, or any other parameter used by the pilot).

(3) Figure A3 illustrates portions of the measured and corrected takeoff flight paths including the significant geometrical relationships influencing sound propagation. EF represents the measured second constant flight path with climb angle γ, and EcFc represents the corrected second constant flight path at reduced climb angle $\gamma-\gamma$. Position Q represents the aircraft location on the measured takeoff flight path for which PNLTM is observed at the noise measuring station K, and Qc is the corresponding position on the corrected flight path. The measured and corrected sound propagation paths are KQ and KQc, respectively, which form the same angle θ with their flight paths. Position R represents the point on the measured takeoff flight path nearest the noise measuring station K, and Rc is the corresponding position on the corrected flight path. The minimum distance to the measured and corrected flight paths are indicated by the lines KR and KRc, respectively, which are normal to their flight paths.

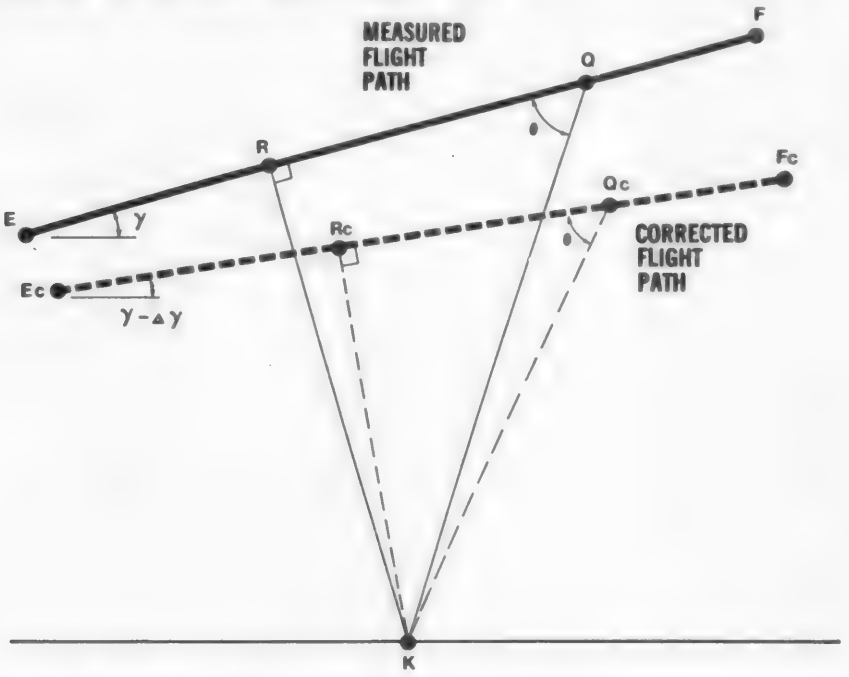


Figure A3. TAKEOFF PROFILE CHARACTERISTICS INFLUENCING SOUND PROPAGATION

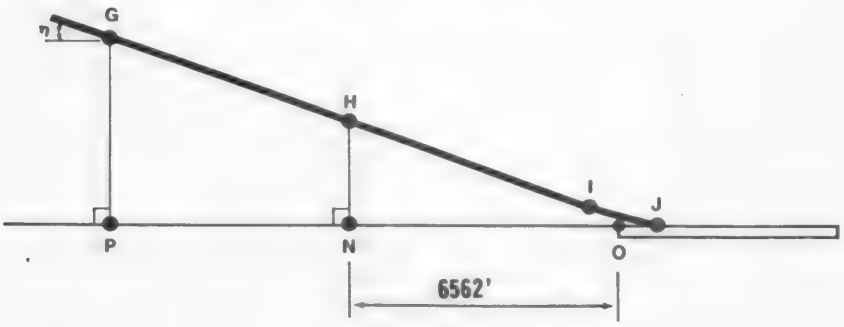


Figure A4. MEASURED APPROACH PROFILE

(c) *Approach profiles.* (1) Figures A4 illustrates a typical approach profile.

(1) The beginning of the noise certification approach profile is represented by aircraft position G whose vertical projection on the flight track (extended centerline of the runway) is point P. The position of the aircraft should be recorded for a distance OP from the runway threshold O to ensure recording of the entire interval during which the measured aircraft noise is within 10 dB of PNLTM.

(ii) The aircraft approaches at an angle passes vertically over the noise measuring station N at a height of NH, begins the level off at position I, and touches down at position J. The distance ON is prescribed as 6,562 feet (2,000 meters).

(iii) The approach profile is defined by the approach angle and the height NH which are functions of the aircraft operating conditions controlled by the pilot. If the measured approach profile parameters do not conform to the corresponding reference approach parameters (3 degrees and 394 feet, respectively, as shown in Figure A5), corrections, if positive, must be applied to the EPNL calculated from the measured data.

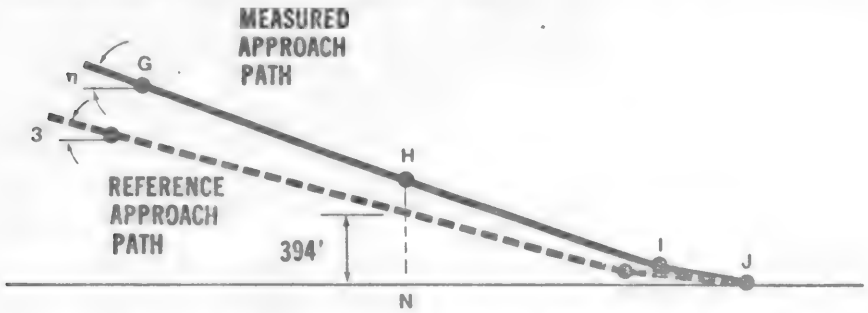


Figure A5. COMPARISON OF MEASURED AND CORRECTED APPROACH PROFILES

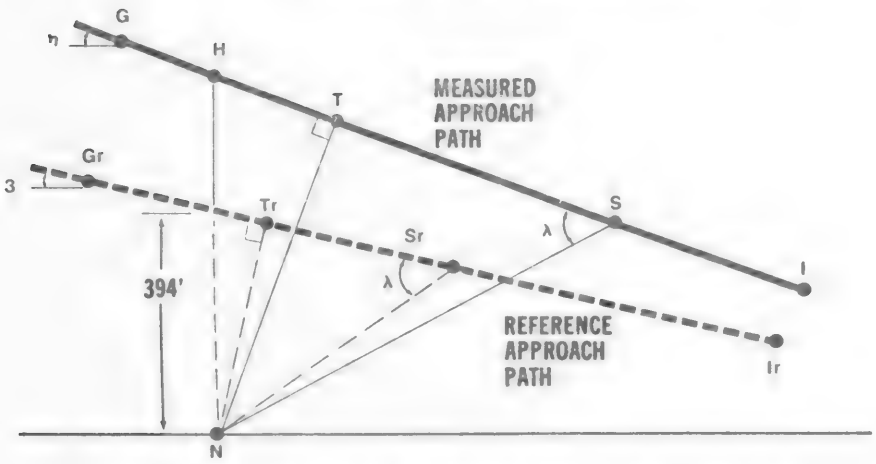


Figure A6. APPROACH PROFILE CHARACTERISTICS INFLUENCING SOUND PROPAGATION

(2) Figure A6 illustrates portions of the measured and reference approach flight paths, including the significant geometrical relationships influencing sound propagation. GI represents the measured approach path with approach angle —, and GrIr represents the reference approach flight path at lower altitude and approach angle of 3 degrees. Position S represents the aircraft location on the measured approach flight path for which PNLTM is observed at the noise measuring station N, and Sr is the corresponding position on the reference approach flight path. The measured and corrected sound propagation paths are NS and NSr, respectively, which form the same angle • with their flight paths. Position T represents the point on the measured approach flight path nearest the noise measuring station N, and Tr is the corresponding point on the reference approach flight path. The minimum distances to the measured and reference flight paths are indicated by the lines NT and NTr, respectively, which are normal to their flight paths. NOTE: The reference approach flight path is defined by —=3 degrees and NH=394 feet. Consequently NTr can also be defined; NTr=393 feet to the nearest foot and is, therefore, considered to be one of the reference parameters.

(d) *PNLT corrections.* If the ambient atmospheric conditions of temperature and

relative humidity are not those prescribed as reference conditions under § A36.5(c) of this appendix (77 degrees F and 70 percent, respectively), corrections to the EPNL values must be calculated from the measured data under paragraph (a) of this section as follows:

(1) *Takeoff flight path.* For the takeoff flight path shown in Figure A3, the spectrum of PNLTM observed at station K for the aircraft at position Q is decomposed into its individual SPLi values.

(i) *Step 1.* A set of corrected values are then computed as follows:

$$\begin{aligned} SPLic = SPLi \quad & +(\alpha i - \alpha io)\,KQ \\ & +\alpha io\,(KQ - KQc) \\ & +20 \log (KQ/KQc) \end{aligned}$$

where SPLi and SPLic are the measured and corrected sound pressure levels, respectively, in the i-th one-third octave band. The first correction term accounts for the effects of change in atmospheric sound absorption where αi and αio are the sound absorption coefficients for the test (determined under § A36.9(d)) and reference atmospheric conditions, respectively, for the i-th one-third octave band and KQ is the measured takeoff sound propagation path. The second correction term accounts for the effects of atmospheric sound absorption on the change in the sound propagation path length where KQc is the corrected takeoff sound propagation path. The third correction term accounts for the effects of the inverse square law on the change in the sound propagation path length.

(ii) *Step 2.* The corrected values of SPLic are then converted to PNLT and a correction term calculated as follows:

$$\Delta 1 = PNLT - PNLTM$$

which represents the correction to be added algebraically to the EPNL calculated from the measured data.

(2) *Approach flight path.*

(i) The procedure prescribed in paragraph (d)(1) of this section for takeoff flight paths is also used for the approach flight path, except that the value for SPLic relate to the approach sound propagation paths shown in Figure A6 as follows:

$$\begin{aligned} SPLic = SPLi \quad & +(\alpha i - \alpha io)\,NS \\ & +\alpha io\,(NS - NSr) \\ & +20 \log (NS/NSr) \end{aligned}$$

where NS and NSr are the measured and reference approach sound propagation paths, respectively.

(ii) The remainder of the procedure is the same as that prescribed in paragraph (d)(1)(ii) of this section, regarding takeoff flight path.

(3) *Sideline flight path.* The procedure prescribed in paragraph (d)(1) of this section for takeoff flight paths is also used for the sideline flight path, except that the values of SPLic relate only to the measured sideline sound propagation path as follows:

$$\begin{aligned} SPLic = SPLi \quad & +(\alpha i - \alpha io)\,LX \\ & +\alpha i\,(LXc) \\ & +20 \log (LX/LXc) \end{aligned}$$

where LX is the measured sideline sound propagation path from station L (Figure A1) to position X of the aircraft for which PNLTM is observed at station L and LXc is the corrected sideline sound propagation path.

(e) *Duration corrections.* If the measured takeoff and approach flight paths do not conform to those prescribed as the corrected and reference flight paths, respectively, under § A36.5(d)(2) it will be necessary, or desirable, to apply duration corrections to the EPNL values calculated from the measured data. Such corrections must be calculated as follows:

(1) *Takeoff flight path.* For the takeoff flight path shown in Figure A3, the correction term is calculated using the formula—

$$\Delta 2 = -10 \log (KR/KRc)$$

which represents the correction which must be added algebraically to the EPNL calculated from the measured data. The lengths KR and KRc are the measured and corrected takeoff minimum distances from the noise measuring station K to the measured and the corrected flight paths, respectively. A negative sign indicates that, for the particular case of a duration correction, the EPNL calculated from the measured data must be reduced if the measured flight path is at a greater altitude than the corrected flight path.

(2) *Approach flight path.* For the approach flight path shown in Figure A6, the correction term is calculated using the formula—

$$\Delta 2 = -10 \log (NT/393)$$

where NT is the measured approach minimum distance from the noise measuring station N to the measured flight path and 393 feet is the minimum distance from station N to the reference flight path.

(3) *Sideline flight path.* For the sideline flight path, the correction term is calculated using the formula—

$$\Delta 2 = -10 \log (LX/LXc)$$

where LX and LX_c are the measured and corrected sideline noise measuring distances, respectively, from the noise measuring station L to the aircraft position X or X_c, respectively on the takeoff flight path.

(f) *Nonstandard takeoff location correction.* All takeoff noise measurements must be conducted at the takeoff noise measurement point prescribed in § 36.1 of Appendix C, except where it is necessary to bring the measuring station to a point closer to the start of takeoff roll to ensure recording the complete flyover noise history required by § B36.9 of Appendix B of this part (i.e., a flyover noise/time record which includes the required period before and after the 10 dB-down points from PNLTM). The EPNL value computed from these measurements must be corrected to the value that would have occurred at the 21,325 foot reference measuring point under one of the following procedures:

(1) *Simplified procedure.* Unless the correction factor exceeds 8.0 dB, or the correction results in a final EPNL value which is within 1.5 dB of the noise levels prescribed in Appendix C of this part, the correction procedure prescribed in paragraphs (d) and (e) of this section may be used. Since this procedure accounts for extrapolation of the PNLTM from the close-in-measurement station to the 21,325 foot reference point, corrections for differences between test and reference thrust and air speed must be made after the EPNL has been corrected to the 21,325 foot reference point.

(2) *Integrated procedure.* If the correction factor exceeds 8.0 dB, or the correction results in a final EPNL value which is within 1.0 dB of the noise levels prescribed in Appendix C of this part, the following correction procedure must be used:

(i) Each ½ second spectrum measured during a flyover at a noise measuring station which is closer to the flight path than the prescribed reference distance must be adjusted under a procedure similar to that prescribed under paragraph (d)(1) of this section, regarding PNLT corrections. However, the distances which must be used are those values of KQ and KQc for the sound propagation path (and hence value of θ) for PNLTM which represents the actual, measured sound propagation path (and path angle), and the corresponding sound propagation path (and path angle) as if the measurements had been made at the 21,325 foot measuring point under reference acoustic-day conditions.

(ii) After the measured ½-second spectra have been corrected to the 21,325 foot reference point, the remaining noise evaluation must be conducted under the procedures prescribed in Appendix B of this part, including the appropriate reference thrust and air speed corrections.

APPENDIX B

3. The heading to Appendix B is amended by adding a table of sections to read as follows:

APPENDIX B—AIRCRAFT NOISE EVALUATION UNDER § 36.103

Sec.
B36.1 *General.*
B36.3 *Perceived noise level.*
B36.5 *Correction for spectral irregularities.*
B36.7 *Maximum tone corrected perceived noise level.*
B36.9 *Duration correction.*
B36.11 *Effective perceived noise level.*
B36.13 *Mathematical formulation of noy tables.*

4. § B36.2 is amended as follows:

a. Redesignate § B36.2 as "§ B36.3".

b. Designate steps 1, 2, and 3 as paragraphs "(a) *Step 1.,*" "(b) *Step 2.,*" and "(c) *Step 3.,*" respectively.

c. At the end of Step 1. of the prescribed procedure, substitute the reference "§ B36.13 of this Appendix; for the reference "§ B36.7 of this Appendix."

d. In the formula prescribed in Step 3, substitute the constant factor "33.22" for the factor "33.3."

5. § B36.3 is amended as follows:

a. Redesignate § B36.3 as "§ B36.5."

b. Designate Steps 1 through 10 of the prescribed procedure as paragraphs "(a) *Step 1.*" through "(j) *Step 10.*", consecutively.

c. In Step 3 of the prescribed procedure, redesignate paragraphs (a), (b), and (c) as paragraphs "(1)," "(2)," and "(3)," respectively.

d. In Step 4 of the prescribed procedure, redesignate paragraphs (a), (b), and (c) as paragraphs "(1)," "(2)," and "(3)," respectively.

e. Designate the last two undesignated paragraphs of the section as paragraphs "(k)," and "(l)," consecutively.

f. At the end of the current text of the section add two new paragraphs, designated "(m)," and "(n)," to read as follows:

(m) Tones resulting from ground-plane reflections in the 800 Hz and lower one-third

octave bands may be excluded from the calculation of corrections for spectral irregularities. To qualify for this exclusion, the pseudotones must be clearly identified as not being related to the engine noise. This identification may be made either by comparing measured data with data from a flush mounted microphone, or by observing the Doppler shift characteristics of the tone during the flyover-noise/time history. Since pseudotones are related to ground reflections, a microphone mounted flush to the ground will yield a spectral shape which can be distinguished from that produced by the 4-foot high microphone at those frequencies which can be related to ground reflection's geometrical relationships. Identification through Doppler shifting (the symmetric variation of frequency with time) can be made because the Doppler frequency variation yields a frequency increase for an approaching signal and a frequency decrease for a receding signal. Pseudotones at frequencies above 800 Hz generally should not yield significant tone corrections. However, for consistency, each tone correction value must be included in the computation for spectral irregularities. While the tone corrections below 800 Hz may be ignored for the spectral irregularity correction, the SPL values must be included in the noy calculation prescribed in § B36.13 of this appendix.

(n) After the value of PNLTM for each flyover-noise/time history, is identified, the frequency for the largest tone correction factor (C(k)) must be identified for the two preceding and the two succeeding, 500-millisecond time intervals, to identify possible tone suppression at PNLTM as a result of band sharing of the tone. If the value of C(k) for PNLTM is less than the average value of C(k) for those five consecutive time intervals, that average value of C(k) must be used to compute a new value for PNLTM.

6. § B36.4 is amended as follows:

a. Redesignate § B36.4 as "§ B36.7."

b. Designate the two undesignated paragraphs as paragraphs "(a)" and "(b)," consecutively.

c. In the sixth line of the first undesignated paragraph, and in the second and third lines of the second undesignated paragraph, in each case substitute the reference "B36.5 of this appendix" for the reference "B36.3 of this appendix."

7. § B36.5 is amended as follows:

a. Redesignate § B36.5 as "§ B36.9."

b. Designate the six undesignated paragraphs as paragraphs "(a)" through "(f)," consecutively.

8. § B36.6 is amended as follows:

a. Redesignate § B36.6 as "§ B36.11."

b. Designate the two undesignated paragraphs as paragraphs "(a)" and "(b)," consecutively.

c. In the last line of the first undesignated paragraph, substitute the reference "B36.7 and B36.9 of this appendix" for the reference "B36.4 and B36.5 of this appendix."

d. In the second and third line of the second undesignated paragraph, substitute the reference "B36.9 of this appendix" for the reference "B36.5 of this appendix."

9. § B36.7 is amended as follows:

a. Redesignate § B36.7 as "§ B36.13."

b. Designate the 3 undesignated paragraphs as paragraphs "(a)," "(b)," and "(c)," consecutively.

10. Three tables contained in Appendix B are amended by substituting the following tables for Table B1, Table B2, and Table B3, respectively.

TABLE B1 - PERCEIVED NOISINESS (NOYs) AS A FUNCTION OF SOUND PRESSURE LEVEL

	1/3 OCTAVE BAND CENTER FREQUENCIES IN Hz (c/s)																						
SPL	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
4																			0.10					
5																		0.10	0.11	0.10				
6																		0.11	0.12	0.11	0.10			
7																		0.12	0.14	0.13	0.11			
8																		0.14	0.16	0.14	0.13			
9																	0.10	0.16	0.17	0.16	0.14			
10																	0.11	0.17	0.19	0.18	0.16	0.10		
11																	0.13	0.19	0.22	0.21	0.18	0.12		
12																0.10	0.14	0.22	0.24	0.24	0.21	0.14		
13																0.11	0.16	0.24	0.27	0.27	0.24	0.16		
14																0.13	0.18	0.27	0.30	0.30	0.27	0.19		
15															0.10	0.14	0.21	0.30	0.33	0.33	0.30	0.22		
16										0.10	0.10	0.10	0.10	0.10	0.11	0.16	0.24	0.33	0.35	0.35	0.33	0.26		
17										0.11	0.11	0.11	0.11	0.11	0.13	0.18	0.27	0.35	0.38	0.38	0.35	0.30	0.10	
18									0.10	0.13	0.13	0.13	0.13	0.13	0.15	0.21	0.30	0.38	0.41	0.41	0.38	0.33	0.12	
19									0.11	0.14	0.14	0.14	0.14	0.14	0.17	0.24	0.33	0.41	0.45	0.45	0.41	0.36	0.14	
20									0.13	0.16	0.16	0.16	0.16	0.16	0.20	0.27	0.36	0.45	0.49	0.49	0.45	0.39	0.17	
21								0.10	0.14	0.18	0.18	0.18	0.18	0.18	0.23	0.30	0.39	0.49	0.53	0.53	0.49	0.42	0.21	0.10
22								0.11	0.16	0.21	0.21	0.21	0.21	0.21	0.26	0.33	0.42	0.53	0.57	0.57	0.53	0.46	0.25	0.11
23								0.13	0.18	0.24	0.24	0.24	0.24	0.24	0.30	0.36	0.46	0.57	0.62	0.62	0.57	0.50	0.30	0.13
24							0.10	0.14	0.21	0.27	0.27	0.27	0.27	0.27	0.33	0.40	0.50	0.62	0.67	0.67	0.62	0.55	0.33	0.15
25							0.11	0.16	0.24	0.30	0.30	0.30	0.30	0.30	0.35	0.43	0.55	0.67	0.73	0.73	0.67	0.60	0.36	0.17
26							0.13	0.18	0.27	0.33	0.33	0.33	0.33	0.33	0.38	0.48	0.60	0.73	0.79	0.79	0.73	0.65	0.39	0.20
27						0.10	0.14	0.21	0.30	0.36	0.35	0.36	0.35	0.35	0.41	0.52	0.65	0.79	0.85	0.85	0.79	0.71	0.42	0.23
28						0.11	0.16	0.24	0.33	0.38	0.38	0.38	0.38	0.38	0.46	0.57	0.71	0.85	0.92	0.92	0.85	0.77	0.46	0.26
29						0.13	0.18	0.27	0.36	0.41	0.41	0.41	0.41	0.41	0.49	0.63	0.77	0.92	1.00	1.00	0.92	0.84	0.50	0.30
30					0.10	0.14	0.21	0.30	0.38	0.45	0.45	0.45	0.45	0.45	0.53	0.69	0.84	1.00	1.07	1.07	1.00	0.92	0.55	0.33
31					0.11	0.16	0.24	0.33	0.41	0.49	0.49	0.49	0.49	0.49	0.57	0.76	0.92	1.07	1.15	1.15	1.07	1.00	0.60	0.37
32					0.13	0.18	0.27	0.36	0.45	0.53	0.53	0.53	0.53	0.53	0.62	0.83	1.00	1.15	1.23	1.23	1.15	1.07	0.65	0.41
33					0.14	0.21	0.30	0.41	0.49	0.57	0.57	0.57	0.57	0.57	0.67	0.91	1.07	1.23	1.32	1.32	1.23	1.15	0.71	0.45
34				0.10	0.16	0.24	0.33	0.43	0.52	0.61	0.61	0.61	0.62	0.62	0.73	1.00	1.15	1.32	1.41	1.41	1.32	1.23	0.77	0.50
35				0.11	0.17	0.26	0.36	0.46	0.56	0.67	0.67	0.67	0.67	0.67	0.79	1.07	1.23	1.41	1.51	1.51	1.41	1.32	0.84	0.55
36				0.12	0.21	0.30	0.40	0.50	0.60	0.73	0.73	0.73	0.73	0.73	0.86	1.15	1.32	1.51	1.62	1.62	1.51	1.41	0.92	0.61
37				0.13	0.24	0.33	0.43	0.55	0.67	0.79	0.79	0.79	0.79	0.79	0.92	1.23	1.41	1.62	1.74	1.74	1.62	1.51	1.00	0.67
38				0.14	0.27	0.37	0.48	0.60	0.73	0.86	0.86	0.86	0.86	0.86	1.00	1.32	1.51	1.74	1.86	1.86	1.74	1.62	1.10	0.74
39			0.11	0.16	0.30	0.41	0.52	0.65	0.79	0.92	0.92	0.92	0.92	0.92	1.07	1.41	1.62	1.86	1.99	1.99	1.86	1.74	1.21	0.82
40			0.12	0.18	0.33	0.44	0.57	0.71	0.86	1.00	1.00	1.00	1.00	1.00	1.15	1.51	1.74	1.99	2.14	2.14	1.99	1.86	1.34	0.90
41			0.14	0.21	0.37	0.50	0.63	0.77	0.92	1.07	1.07	1.07	1.07	1.07	1.23	1.62	1.86	2.14	2.29	2.29	2.14	1.99	1.48	1.00
42			0.16	0.24	0.41	0.55	0.70	0.84	1.00	1.15	1.15	1.15	1.15	1.15	1.32	1.74	1.99	2.29	2.45	2.45	2.29	2.14	1.63	1.10
43			0.19	0.27	0.46	0.61	0.77	0.92	1.07	1.23	1.23	1.23	1.23	1.23	1.41	1.86	2.14	2.45	2.63	2.63	2.45	2.29	1.79	1.21
44		0.10	0.22	0.30	0.50	0.67	0.84	1.00	1.15	1.32	1.32	1.32	1.32	1.32	1.52	1.99	2.29	2.63	2.81	2.81	2.63	2.45	1.99	1.34
45		0.11	0.25	0.33	0.56	0.74	0.91	1.08	1.24	1.41	1.41	1.41	1.41	1.41	1.62	2.14	2.45	2.81	3.02	3.02	2.81	2.63	2.14	1.48
46		0.14	0.28	0.36	0.61	0.80	1.00	1.16	1.33	1.52	1.52	1.52	1.52	1.52	1.74	2.29	2.63	3.02	3.23	3.23	3.02	2.81	2.29	1.63
47		0.16	0.32	0.41	0.67	0.89	1.09	1.26	1.45	1.64	1.64	1.64	1.64	1.64	1.87	2.45	2.81	3.23	3.46	3.46	3.23	3.02	2.45	1.79
48		0.19	0.35	0.45	0.74	1.00	1.17	1.36	1.56	1.74	1.74	1.74	1.74	1.74	2.00	2.63	3.02	3.46	3.71	3.71	3.46	3.23	2.63	1.98
49	0.10	0.22	0.43	0.55	0.82	1.08	1.26	1.45	1.64	1.87	1.87	1.87	1.87	1.87	2.14	2.81	3.23	3.71	3.97	3.97	3.71	3.46	2.81	2.18

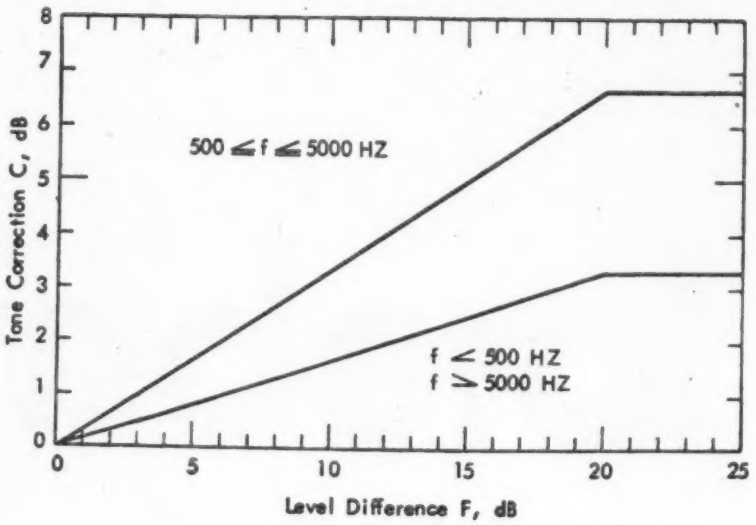
TABLE B1 CONTINUED

SPL	1/3 OCTAVE BAND CENTER FREQUENCIES IN Hz (c/s)																							
	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
50	.12	.26	.49	.72	.90	1.17	1.36	1.56	1.76	2.00	2.00	2.00	2.00	2.00	2.30	3.02	3.46	3.97	4.26	4.26	3.97	3.71	3.02	2.40
51	.14	.30	.55	.80	1.00	1.26	1.47	1.68	1.89	2.14	2.14	2.14	2.14	2.14	2.46	3.23	3.71	4.26	4.56	4.56	4.26	3.97	3.23	2.63
52	.17	.34	.62	.90	1.09	1.36	1.59	1.80	2.03	2.30	2.30	2.30	2.30	2.30	2.64	3.46	3.97	4.56	4.89	4.89	4.56	4.26	3.46	2.81
53	.21	.39	.70	1.00	1.19	1.47	1.71	1.94	2.17	2.46	2.46	2.46	2.46	2.46	2.83	3.71	4.26	4.89	5.24	5.24	4.89	4.56	3.71	3.02
54	.25	.45	.79	1.09	1.28	1.58	1.85	2.09	2.33	2.64	2.64	2.64	2.64	2.64	3.03	3.97	4.56	5.24	5.61	5.61	5.24	4.89	3.97	3.23
55	.30	.51	.89	1.19	1.38	1.71	2.00	2.25	2.50	2.83	2.83	2.83	2.83	2.83	3.25	4.26	4.89	5.61	6.01	6.01	5.61	5.24	4.26	3.46
56	.34	.59	1.00	1.29	1.50	1.85	2.15	2.42	2.69	3.03	3.03	3.03	3.03	3.03	3.48	4.56	5.24	6.01	6.44	6.44	6.01	5.61	4.56	3.71
57	.39	.67	1.09	1.40	1.63	2.00	2.33	2.61	2.88	3.25	3.25	3.25	3.25	3.25	3.73	4.89	5.61	6.44	6.90	6.90	6.44	6.01	4.89	3.97
58	.45	.77	1.18	1.53	1.77	2.15	2.51	2.81	3.10	3.48	3.48	3.48	3.48	3.48	4.00	5.24	6.01	6.90	7.39	7.39	6.90	6.44	5.24	4.26
59	.51	.87	1.29	1.66	1.92	2.33	2.71	3.03	3.32	3.73	3.73	3.73	3.73	3.73	4.29	5.61	6.44	7.39	7.92	7.92	7.39	6.90	5.61	4.56
60	.59	1.00	1.40	1.81	2.08	2.51	2.93	3.26	3.57	4.00	4.00	4.00	4.00	4.00	4.59	6.01	6.90	7.92	8.49	8.49	7.92	7.39	6.01	4.89
61	.67	1.10	1.53	1.97	2.26	2.71	3.16	3.51	3.83	4.29	4.29	4.29	4.29	4.29	4.92	6.44	7.39	8.49	9.09	9.09	8.49	7.92	6.44	5.24
62	.77	1.21	1.66	2.15	2.45	2.93	3.41	3.79	4.11	4.59	4.59	4.59	4.59	4.59	5.28	6.90	7.92	9.09	9.74	9.74	9.09	8.49	6.90	5.61
63	.87	1.32	1.81	2.34	2.65	3.16	3.69	4.06	4.41	4.92	4.92	4.92	4.92	4.92	5.66	7.39	8.49	9.74	10.4	10.4	9.74	9.09	7.39	6.01
64	1.00	1.45	1.97	2.54	2.88	3.41	3.98	4.38	4.73	5.28	5.28	5.28	5.28	5.28	6.06	7.92	9.09	10.4	11.2	11.2	10.4	9.74	7.92	6.44
65	1.11	1.60	2.15	2.77	3.12	3.69	4.30	4.71	5.08	5.66	5.66	5.66	5.66	5.66	6.50	8.49	9.74	11.2	12.0	12.0	11.2	10.4	8.49	6.90
66	1.22	1.75	2.34	3.01	3.39	3.99	4.64	5.07	5.45	6.06	6.06	6.06	6.06	6.06	6.96	9.09	10.4	12.0	12.8	12.8	12.0	11.2	9.09	7.39
67	1.35	1.92	2.54	3.28	3.68	4.30	5.01	5.46	5.85	6.50	6.50	6.50	6.50	6.50	7.46	9.74	11.2	12.8	13.8	13.8	12.8	12.0	9.74	7.92
68	1.49	2.11	2.77	3.57	3.99	4.64	5.41	5.88	6.27	6.96	6.96	6.96	6.96	6.96	8.00	10.4	12.0	13.8	14.7	14.7	13.8	12.8	10.4	8.49
69	1.65	2.32	3.01	3.88	4.33	5.01	5.84	6.33	6.73	7.46	7.46	7.46	7.46	7.46	8.57	11.2	12.8	14.7	15.8	15.8	14.7	13.8	11.2	9.09
70	1.82	2.55	3.28	4.23	4.69	5.41	6.31	6.81	7.23	8.00	8.00	8.00	8.00	8.00	9.19	12.0	13.8	15.8	16.9	16.9	15.8	14.7	12.0	9.74
71	2.02	2.79	3.57	4.60	5.09	5.84	6.81	7.33	7.75	8.57	8.57	8.57	8.57	8.57	9.85	12.8	14.7	16.9	18.1	18.1	16.9	15.8	12.8	10.4
72	2.23	3.07	3.88	5.01	5.52	6.31	7.36	7.90	8.32	9.19	9.19	9.19	9.19	9.19	10.6	13.8	15.8	18.1	19.4	19.4	18.1	16.9	13.8	11.2
73	2.46	3.37	4.23	5.45	5.99	6.81	7.94	8.50	8.93	9.85	9.85	9.85	9.85	9.85	11.3	14.7	16.9	19.4	20.8	20.8	19.4	18.1	14.7	12.0
74	2.72	3.70	4.60	5.94	6.50	7.36	8.57	9.15	9.59	10.6	10.6	10.6	10.6	10.6	12.1	15.8	18.1	20.8	22.3	22.3	20.8	19.4	15.8	12.8
75	3.01	4.06	5.01	6.46	7.05	7.94	9.19	9.85	10.3	11.3	11.3	11.3	11.3	11.3	13.0	16.9	19.4	22.3	23.9	23.9	22.3	20.8	16.9	13.8
76	3.32	4.46	5.45	7.03	7.65	8.57	9.85	10.6	11.0	12.1	12.1	12.1	12.1	12.1	13.9	18.1	20.8	23.9	25.6	25.6	23.9	22.3	18.1	14.7
77	3.67	4.89	5.94	7.66	8.29	9.19	10.6	11.3	11.8	13.0	13.0	13.0	13.0	13.0	14.9	19.4	22.3	25.6	27.4	27.4	25.6	23.9	19.4	15.8
78	4.06	5.37	6.46	8.33	9.00	9.85	11.3	12.1	12.7	13.9	13.9	13.9	13.9	13.9	16.0	20.8	23.9	27.4	29.4	29.4	27.4	25.6	20.8	16.9
79	4.49	5.90	7.03	9.07	9.76	10.6	12.1	13.0	13.6	14.9	14.9	14.9	14.9	14.9	17.1	22.3	25.6	29.4	31.5	31.5	29.4	27.4	22.3	18.1
80	4.96	6.48	7.66	9.85	10.6	11.3	13.0	13.9	14.6	16.0	16.0	16.0	16.0	16.0	18.4	23.9	27.4	31.5	33.7	33.7	31.5	29.4	23.9	19.4
81	5.48	7.11	8.33	10.6	11.3	12.1	13.9	14.9	15.7	17.1	17.1	17.1	17.1	17.1	19.7	25.6	29.4	33.7	36.1	36.1	33.7	31.5	25.6	20.8
82	6.06	7.91	9.07	11.3	12.1	13.0	14.9	16.0	16.9	18.4	18.4	18.4	18.4	18.4	21.1	27.4	31.5	36.1	38.7	38.7	36.1	33.7	27.4	22.3
83	6.70	8.57	9.87	12.1	13.0	13.9	16.0	17.1	18.1	19.7	19.7	19.7	19.7	19.7	22.6	29.4	33.7	38.7	41.5	41.5	38.7	36.1	29.4	23.9
84	7.41	9.41	10.7	13.0	13.9	14.9	17.1	18.4	19.4	21.1	21.1	21.1	21.1	21.1	24.3	31.5	36.1	41.5	44.4	44.4	41.5	38.7	31.5	25.6
85	8.19	10.3	11.7	13.9	14.9	16.0	18.4	19.7	20.8	22.6	22.6	22.6	22.6	22.6	26.0	33.7	38.7	44.4	47.6	47.6	44.4	41.5	33.7	27.4
86	9.05	11.3	12.7	14.9	16.0	17.1	19.7	21.1	22.4	24.3	24.3	24.3	24.3	24.3	27.9	36.1	41.5	47.6	51.0	51.0	47.6	44.4	36.1	29.4
87	10.0	12.1	13.9	16.0	17.1	18.4	21.1	22.6	24.0	26.0	26.0	26.0	26.0	26.0	29.9	38.7	44.4	51.0	54.7	54.7	51.0	47.6	38.7	31.5
88	11.1	13.0	14.9	17.1	18.4	19.7	22.6	24.3	25.8	27.9	27.9	27.9	27.9	27.9	32.0	41.5	47.6	54.7	58.6	58.6	54.7	51.0	41.5	33.7
89	12.2	13.9	16.0	18.4	19.7	21.1	24.3	26.0	27.7	29.9	29.9	29.9	29.9	29.9	34.3	44.4	51.0	58.6	62.7	62.7	58.6	54.7	44.4	36.1
90	13.5	14.9	17.1	19.7	21.1	22.6	26.0	27.9	29.7	32.0	32.0	32.0	32.0	32.0	36.8	47.6	54.7	62.7	67.2	67.2	62.7	58.6	47.6	38.7
91	14.9	16.0	18.4	21.1	22.6	24.3	27.9	29.9	31.8	34.3	34.3	34.3	34.3	34.3	39.4	51.0	58.6	67.2	72.0	72.0	67.2	62.7	51.0	41.5
92	16.0	17.1	19.7	22.6	24.3	26.0	29.9	32.0	34.2	36.8	36.8	36.8	36.8	36.8	42.2	54.7	62.7	72.0	77.2	77.2	72.0	67.2	54.7	44.4
93	17.1	18.4	21.1	24.3	26.0	27.9	32.0	34.3	36.7	39.4	39.4	39.4	39.4	39.4	45.3	58.6	67.2	77.2	82.7	82.7	77.2	72.0	58.6	47.6
94	18.4	19.7	22.6	26.0	27.9	29.9	34.3	36.8	39.4	42.2	42.2	42.2	42.2	42.2	48.5	62.7	72.0	82.7	88.6	88.6	82.7	77.2	62.7	51.0
95	19.7	21.1	24.3	27.9	29.9	32.0	36.8	39.4	42.2	45.3	45.3	45.3	45.3	45.3	52.0	67.2	77.2	88.6	94.9	94.9	88.6	82.7	67.2	54.7
96	21.1	22.6	26.0	29.9	32.0	34.3	39.4	42.2	45.3	48.5	48.5	48.5	48.5	48.5	55.7	72.0	82.7	94.9	102	102	94.9	88.6	72.0	58.6
97	22.6	24.3	27.9	32.0	34.3	36.8	42.2	45.3	48.5	52.0	52.0	52.0	52.0	52.0	59.7	77.2	88.6	102	109	109	102	94.9	77.2	62.7
98	24.3	26.0	29.9	34.3	36.8	39.4	45.3	48.5	52.0	55.7	55.7	55.7	55.7	55.7	64.0	82.7	94.9	109	117	117	109	102	82.7	67.2
99	26.0	27.9	32.0	36.8	39.4	42.2	48.5	52.0	55.7	59.7	59.7	59.7	59.7	59.7	68.6	88.6	102	117	125	125	117	109	88.6	72.0

TABLE B1 CONTINUED

	1/3 OCTAVE BAND CENTER FREQUENCIES IN Hz (c/s)																						
SPL	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
100	27.9	29.9	34.3	39.4	42.2	45.3	52.0	55.7	59.7	64.0	64.0	64.0	64.0	64.0	73.5	94.9	109	125	134	134	125	117	94.9	77.2
101	29.9	32.0	36.8	42.2	45.3	48.5	55.7	59.7	64.0	68.6	68.6	68.6	68.6	68.6	78.8	102	117	134	144	144	134	125	102	82.7
102	32.0	34.3	39.4	45.3	48.5	52.0	59.7	64.0	68.6	73.5	73.5	73.5	73.5	73.5	84.4	109	125	144	154	154	144	134	109	88.6
103	34.3	36.8	42.2	48.5	52.0	55.7	64.0	68.6	73.5	78.8	78.8	78.8	78.8	78.8	90.5	117	134	154	165	165	154	144	117	94.9
104	36.8	39.4	45.3	52.0	55.7	59.7	68.6	73.5	78.8	84.4	84.4	84.4	84.4	84.4	97.0	125	144	165	177	177	165	154	125	102
105	39.4	42.2	48.5	55.7	59.7	64.0	73.5	78.8	84.4	90.5	90.5	90.5	90.5	90.5	104	134	154	177	189	189	177	165	134	109
106	42.2	45.3	52.0	59.7	64.0	68.6	78.8	84.4	90.5	97.0	97.0	97.0	97.0	97.0	111	144	165	189	203	203	189	177	144	117
107	45.3	48.5	55.7	64.0	68.6	73.5	84.4	90.5	97.0	104	104	104	104	104	119	154	177	203	217	217	203	189	154	125
108	48.5	52.0	59.7	68.6	73.5	78.8	90.5	97.0	104	111	111	111	111	111	128	165	189	217	233	233	217	203	165	134
109	52.0	55.7	64.0	73.5	78.8	84.4	97.0	104	111	119	119	119	119	119	137	177	203	233	249	249	233	217	177	144
110	55.7	59.7	68.6	78.8	84.4	90.5	104	111	119	128	128	128	128	128	147	189	217	249	267	267	249	233	189	154
111	59.7	64.0	73.5	84.4	90.5	97.0	111	119	128	137	137	137	137	137	158	203	233	267	286	286	267	249	203	165
112	64.0	68.6	78.8	90.5	97.0	104	119	128	137	147	147	147	147	147	169	217	249	286	307	307	286	267	217	177
113	68.6	73.5	84.4	97.0	104	111	128	137	147	158	158	158	158	158	181	233	267	307	329	329	307	286	233	189
114	73.5	78.8	90.5	104	111	119	137	147	158	169	169	169	169	169	194	249	286	329	352	352	329	307	249	203
115	78.8	84.4	97.0	111	119	128	147	158	169	181	181	181	181	181	208	267	307	352	377	377	352	329	267	217
116	84.4	90.5	104	119	128	137	158	169	181	194	194	194	194	194	223	286	329	377	404	404	377	352	286	233
117	90.5	97.0	111	128	137	147	169	181	194	208	208	208	208	208	239	307	352	404	433	433	404	377	307	249
118	97.0	104	119	137	147	158	181	194	208	223	223	223	223	223	256	329	377	433	464	464	433	404	329	267
119	104	111	128	147	158	169	194	208	223	239	239	239	239	239	274	352	404	464	497	497	464	433	352	286
120	111	119	137	158	169	181	208	223	239	256	256	256	256	256	294	377	433	497	533	533	497	464	377	307
121	119	128	147	169	181	194	223	239	256	274	274	274	274	274	315	404	464	533	571	571	533	497	404	329
122	128	137	158	181	194	208	239	256	274	294	294	294	294	294	338	433	497	571	611	611	571	533	433	352
123	137	147	169	194	208	223	256	274	294	315	315	315	315	315	362	464	533	611	655	655	611	571	464	377
124	147	158	181	208	223	239	274	294	315	338	338	338	338	338	388	497	571	655	702	702	655	611	497	404
125	158	169	194	223	239	256	294	315	338	362	362	362	362	362	416	533	611	702	752	752	702	655	533	433
126	169	181	208	239	256	274	315	338	362	388	388	388	388	388	446	571	655	752	806	806	752	702	571	464
127	181	194	223	256	274	294	338	362	388	416	416	416	416	416	479	611	702	806	863	863	806	752	611	497
128	194	208	239	274	294	315	362	388	416	446	446	446	446	446	512	655	752	863	925	925	863	806	655	533
129	208	223	256	294	315	338	388	416	446	478	478	478	478	478	549	702	806	925	991	991	925	863	702	571
130	223	239	274	315	338	362	416	446	478	512	512	512	512	512	588	752	863	991	1062	1062	991	925	752	611
131	239	256	294	338	362	388	446	478	512	549	549	549	549	549	630	806	925	1062	1137	1137	1062	991	806	655
132	256	274	315	362	388	416	478	512	549	588	588	588	588	588	676	863	991	1137	1219	1219	1137	1062	863	702
133	274	294	338	388	416	446	512	549	588	630	630	630	630	630	724	925	1062	1219	1306	1306	1219	1137	925	752
134	294	315	362	416	446	478	549	588	630	676	676	676	676	676	776	991	1137	1306	1399	1399	1306	1219	991	806
135	315	338	388	446	478	512	588	630	676	724	724	724	724	724	832	1062	1219	1399	1499	1499	1399	1306	1062	863
136	338	362	416	478	512	549	630	676	724	776	776	776	776	776	891	1137	1306	1499	1606	1606	1499	1399	1137	925
137	362	388	446	512	549	588	676	724	776	832	832	832	832	832	955	1219	1399	1606	1721	1721	1606	1499	1219	991
138	388	416	478	549	588	630	724	776	832	891	891	891	891	891	1024	1306	1499	1721	1844	1844	1721	1606	1306	1062
139	416	446	512	588	630	676	776	832	891	955	955	955	955	955	1096	1399	1606	1844	1975	1975	1844	1721	1399	1137
140	446	478	549	630	676	724	832	891	955	1024	1024	1024	1024	1024	1176	1499	1721	1975			1975	1844	1499	1219
141	478	512	588	676	724	776	891	955	1024	1098	1098	1098	1098	1098	1261	1606	1844					1975	1606	1306
142	512	549	630	724	776	832	955	1024	1098	1176	1176	1176	1176	1176	1351	1721	1975						1721	1399
143	549	588	676	776	832	891	1024	1098	1176	1261	1261	1261	1261	1261	1448	1844							1844	1499
144	588	630	724	832	891	955	1098	1176	1261	1351	1351	1351	1351	1351	1552	1975							1975	1606
145	630	676	776	891	955	1024	1176	1261	1351	1448	1448	1448	1448	1448	1664									1721
146	676	724	832	955	1024	1098	1261	1351	1448	1552	1552	1552	1552	1552	1783									1844
147	724	776	891	1024	1098	1176	1351	1448	1552	1664	1664	1664	1664	1664	1911									1975
148	776	832	955	1098	1176	1261	1448	1552	1664	1783	1783	1783	1783	1783	2048									
149	832	891	1024	1176	1261	1351	1552	1664	1783	1911	1911	1911	1911	1911										
150	891	955	1098	1261	1351	1448	1664	1783	1911	2048	2048	2048	2048	2048										

TABLE B2. Tone correction factors.



Frequency f, HZ	Level Difference F, dB	Tone Correction C, dB
50 ≤ f < 500	0 ≤ F < 20 20 ≤ F	F/6 3 1/3
500 ≤ f ≤ 5000	0 ≤ F < 20 20 ≤ F	F/3 6 2/3
5000 < f ≤ 10000	0 ≤ F < 20 20 ≤ F	F/6 3 1/3

TABLE B3. Example of tone correction calculation for a turbofan engine.

① Band (i)	② f HZ	③ SPL dB	④ S dB Step 1	⑤ |ΔS| dB Step 2	⑥ SPL' dB Step 4	⑦ S' dB Step 5	⑧ $\bar{S}$ dB Step 6	⑨ SPL" dB Step 7	⑩ F dB Step 8	⑪ C dB Step 9
1	50	-	-	-	-	-	-	-	-	-
2	63	-	-	-	-	-	-	-	-	-
3	80	70	-	-	70	-8	-2 1/3	70	-	
4	100	62	- 8	-	62	-8	+3 1/3	67 2/3	-	
5	125	(70)	+(8)	16	71	+9	+6 2/3	71	-	
6	160	80	+10	2	80	+9	+2 2/3	77 2/3	2 1/3	1/3
7	200	82	+(2)	8	82	+2	-1 1/3	80 1/3	1 2/3	1/3
8	250	(83)	+ 1	1	79	-3	-1 1/3	79	4	2/3
9	315	76	-(7)	8	76	-3	+ 1/3	77 2/3	-	
10	400	(80)	+(4)	11	78	+2	+1	78	2	1/3
11	500	80	0	4	80	+2	0	79	1	1/3
12	630	79	- 1	1	79	-1	0	79	-	
13	800	78	- 1	0	78	-1	- 1/3	79	-	
14	1000	80	+ 2	3	80	+2	- 2/3	78 2/3	1 1/3	1/3
15	1250	78	- 2	4	78	-2	- 1/3	78	-	
16	1600	76	- 2	0	76	-2	+ 1/3	77 2/3	-	
17	2000	79	+ 3	5	79	+3	+1	78	1	1/3
18	2500	(85)	+ 6	3	79	0	- 1/3	79	6	[2]
19	3150	79	-(6)	12	79	0	-2 2/3	78 2/3	1/3	0
20	4000	78	- 1	5	78	-1	-6 1/3	76	2	2/3
21	5000	71	-(7)	6	71	-7	-8	69 2/3	1 1/3	1/3
22	6300	60	-11	4	60	-11	-8 2/3	61 2/3	-	
23	8000	54	- 6	5	54	-6	-8	53	1	0
24	10000	45	- 9	3	45	-9	-	45	-	
						-9				

Step 1	③(i) - ③(i-1)
Step 2	|④(i) - ④(i-1)|
Step 3	see instructions
Step 4	see instructions
Step 5	⑥(i) - ⑥(i-1)

Step 6	[⑦(i) + ⑦(i+1) + ⑦(i+2)] ÷ 3
Step 7	⑨(i-1) + ⑧(i-1)
Step 8	③(i) - ⑨(i)
Step 9	see Table B2

APPENDIX C

11. The heading to Appendix C is amended by adding a table of sections to read as follows:

APPENDIX C—NOISE LEVELS FOR SUBSONIC TRANSPORT CATEGORY AND TURBOJET POWERED AIRPLANES UNDER SECTION 36.201

Sec.
C36.1 Noise measurement and evaluation.
C36.3 Noise measuring points.
C36.5 Noise levels.
C36.7 Takeoff test conditions.
C36.9 Approach test conditions.

APPENDIX F

12. The heading to Appendix F is amended by adding a table of sections to read as follows:

APPENDIX F—NOISE REQUIREMENTS FOR PROPELLER-DRIVEN SMALL AIRPLANES

PART A—GENERAL

Sec.
F36.1 Scope.

PART B—NOISE MEASUREMENT

Sec.
F36.101 General test conditions.
F36.103 Acoustical measurement system.
F36.105 Sensing, recording, and reproducing equipment.
F36.107 Noise measurement procedures.
F36.109 Data recording, reporting, and approval.
F36.111 Flight procedures.

PART C—DATA CORRECTION

Sec.
F36.201 Correction of data.
F36.203 Validity of results.

PART D—NOISE LIMITS

Sec.
F36.301 Aircraft noise limits.

13. Paragraph (b) of § F36.105 is revised to read as follows:

§ F36.105 *Sensing, recording, and reproducing equipment.*

* * * * *

(b) The characteristics of the system must comply with the recommendations in International Electrotechnical Commission (IEC) Publication No. 179, entitled "Precision Sound Level Meters" as incorporated by reference in Part 36 under § 36.6 of this part.

* * * * *

(Secs. 313(a), 601, 603, 611(b), Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, 1423, and 1431(b)); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); Title I of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.); and Executive Order 11514, March 5, 1970.)

NOTE.—The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Statement under Executive Order 11821, as amended by Executive Order 11949, and OMB Circular A-107.

Issued in Washington, D.C., on February 17, 1978.

LANGHORNE BOND,
Administrator.

NOTE.—The incorporations by reference in the preceding document were approved by the Director of the FEDERAL REGISTER on July 6, 1977.

[FR Doc. 78-5045 Filed 3-1-78; 8:45 am]